AUTOMOTIVE and Aviation INDUSTRIES

AUGUST 1, 1944

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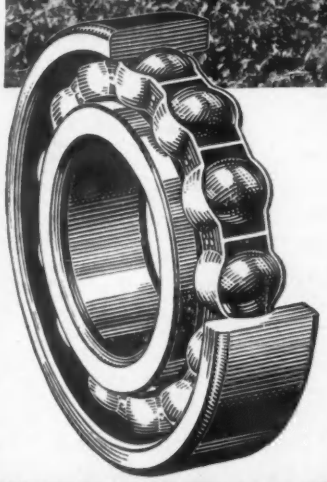


OVER two hundred million New Departure Ball Bearings in this war have served to clinch the reputation of this superior product for peace-time use. In machines wherever shafts revolve or reciprocate they simplify design, locate parts accurately and reduce maintenance.

Nothing rolls like a ball!

New Departure • Division of General Motors • Bristol, Connecticut

NEW DEPARTURE

BALL BEARINGS

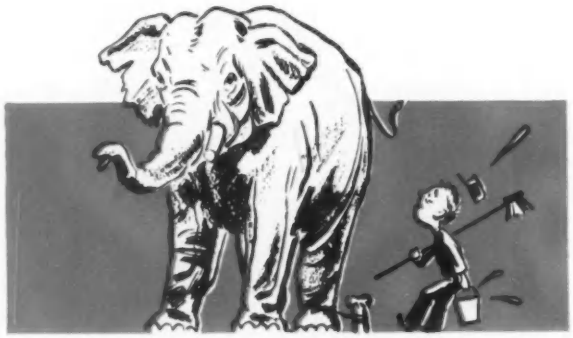
3289

AUG 10 1944

Cutting oil *News* letter

Practical suggestions from the field on how cutting oils and coolants are being used by midwest machine operators to lick tough wartime jobs

AUGUST, 1944



A big washing job was eliminated on bomb ends by a Michigan bomb maker when he shifted to Stanicool H.D. Soluble Oil. A heavy-duty product was needed to get good tool life, tapping 5½"—12 threads in ends of 250 lb. bombs of SAE 1035 forged steel. Stanicool H.D. was the only oil tried that gave desired tool life *plus* easy removal—a valuable time saver because the bomb ends had to be painted.

Automatics old enough to vote were pressed into service by an Illinois war plant. They did the job except that on some of these old machines excessive leakage of bearing oil into the sump diluted the cutting oil at a rapid rate. This in turn materially reduced tool life. The problem was solved without time-taking and expensive machine rebuilding. A Standard Lubrication Engineer suggested adding Acme Base Oil Extra Heavy periodically to the cutting oil. This replenished the compounding, kept up tool life, and eliminated throwing away sump after sump full of oil. It's in emergencies like these that you'll find Standard Lubrication Engineers most helpful.

Jerky action of gun-rifling broaches is often caused by the weight of heavy broach and ram breaking down the lubricating film of ordinary lubricants used on ways. One broach maker found Stanolex 31 just what he needed. Because of the filter used in the system for lubricating the ways, heavy-bodied oils could not be used. Stanolex 31 was light enough in viscosity to be used in the system and tough enough to maintain a lubricating film that gave the ram smooth, even action.

To get good tool life plus a satisfactory finish without grinding, posed a problem for a Michigan plant. The job is produced from 6150 hot rolled steel on a Gridley Automatic. Several cutting oils were tried, but Acme Cutting Oil 110—mixed with 2 parts of paraffin oil—was the only oil that gave good enough finish to eliminate a grinding operation, and at the same time cut tool grinding to twice a shift. This added 15% to a day's production—a lot of parts when one is produced every 28 seconds.

Have you investigated Standard's Coded Lubrication Service—a simple numerical system for getting the *right* lubricant in all the *right* places. Your Standard Industrial Service Representative will be glad to explain it—and tell you how you can put it to work in your plant. Call the local Standard Oil Company (Indiana) office, or write 910 S. Michigan Avenue, Chicago 80, Illinois for the Engineer nearest you. In Nebraska, write Standard Oil Company of Nebraska at Omaha 2.

Gasoline Powers the Attack . . . Don't Waste a Drop!

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

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60,000-lb. main drum line pull!

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● Logging equipment means rugged machinery, such as the double drum hoist or yarder pictured above. It's one of the powerful machines turned out by Clyde Iron Works, Inc. . . . typical of the heavy-duty equipment in which the extra-heavy demands on the gear box are met by COTTA transmissions. For over 30 years COTTA has been a source of custom-designed transmission units for locomotive cranes, oil-well drilling rigs, power excavators, and the like. COTTA's special distinction is providing smooth, quiet, highly efficient, low-cost transmission of power for the job having exacting space limitations. What is *your* problem? A letter outlining your needs will receive prompt attention . . . or write for free illustrated brochure today!

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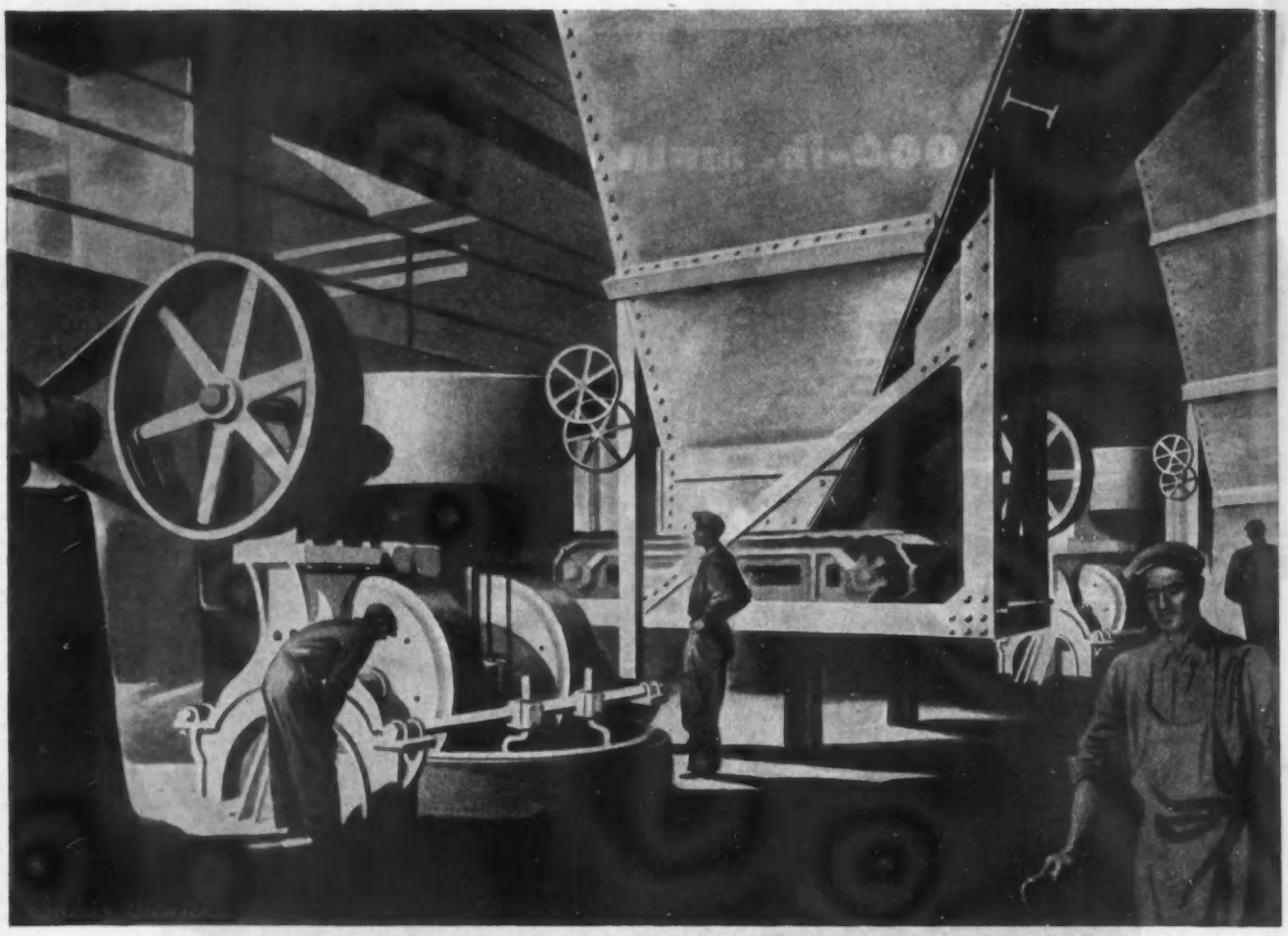

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to KEEP 'EM PRODUCING!

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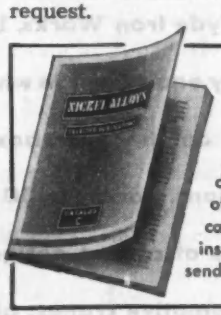
For many years it has been our privilege to cooperate with foundrymen and engineers who desired help in the selection, fabrication and heat treatment of alloys. If you'd like to have such assistance... whatever your industry may be... counsel and data are available on request.



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CONTENTS

Plant Clearance—What Must be Done to Speed Up Recoveries. *By George Roney* 17
Flail Tanks Clear Minefields in Normandy 19
An Air Power Policy for America. *By Eugene E. Wilson* 20
Gabriel Products on Military Vehicles and Warplanes. *By Joseph Geschelin* 22
Gas Turbine Development—Past and Present. *By P. M. Heldt* 26
German Aerial Torpedo Powered by Jet Propulsion Engine of Compressorless Type. *By M. W. Bourdon* 31
Copper Brazing as a Production Tool. *By C. L. Hibert* 32
CED Views on Disposal of Government Surplus Property 36
New Production Equipment 37
War Work Prevents Resumption of Passenger Car Production. *By Donald Browne* 38
New Products for Aircraft 39
New Products 40
Wright Engine Cylinder Barrels Equipped with Aluminum Fins 41
News of the Industry 42
Calendar of Coming Events 48
Advertisers' Index 160

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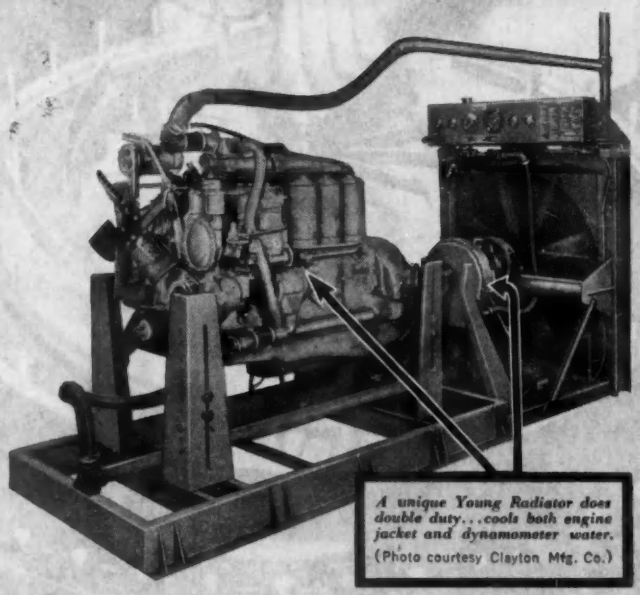
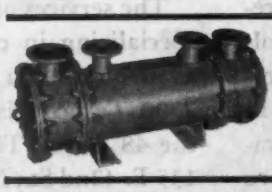
A RADIATOR THAT LEADS A DOUBLE LIFE



A unique Young Radiator does double duty...cools both engine jacket and dynamometer water.
(Photo courtesy Clayton Mfg. Co.)

★ **Run-in tests of new and rebuilt engines are now simplified and speeded up by a new type hydraulic dynamometer that requires no outside electric current or coolant supply. Engine and power absorption heat loads are handled by a double duty radiator designed by Young Heat Transfer Engineers. One section cools the jacket water of the engine on test and another cools the water of the dynamometer. Other Young units are doing equally unusual jobs on land, sea, and in the air. Whatever your heat transfer problem may be, Young engineers can help you to a solution.**



Young Tube Bundle and Shell Heat Exchangers are used in aircraft engine run-in tests. At the start live steam is run through them to quickly bring lube oil up to operating temperature, then cold water to carry off excessive engine heat. Tube bundle has free expansion and contraction features. Easily installed and serviced.

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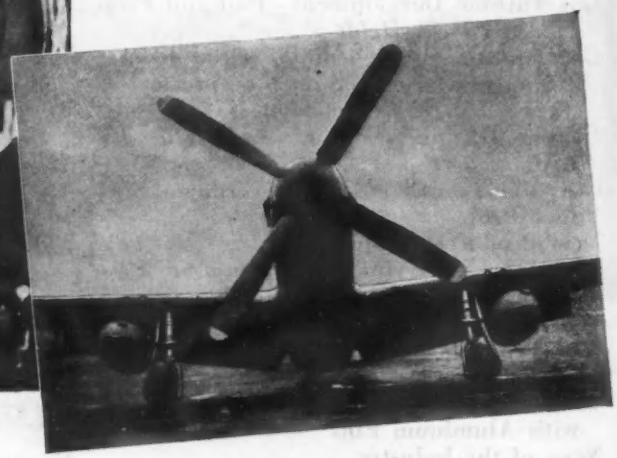

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Spinning at more than 20,000 r.p.m., superchargers must be machined to the nth degree of accuracy. Doing this on a production basis requires the most suitable cutting coolants available. Whether for fine precision work or hogging off metal in the roughest of machining operations, machine-shops everywhere prefer Texaco Cutting and Soluble Oils.

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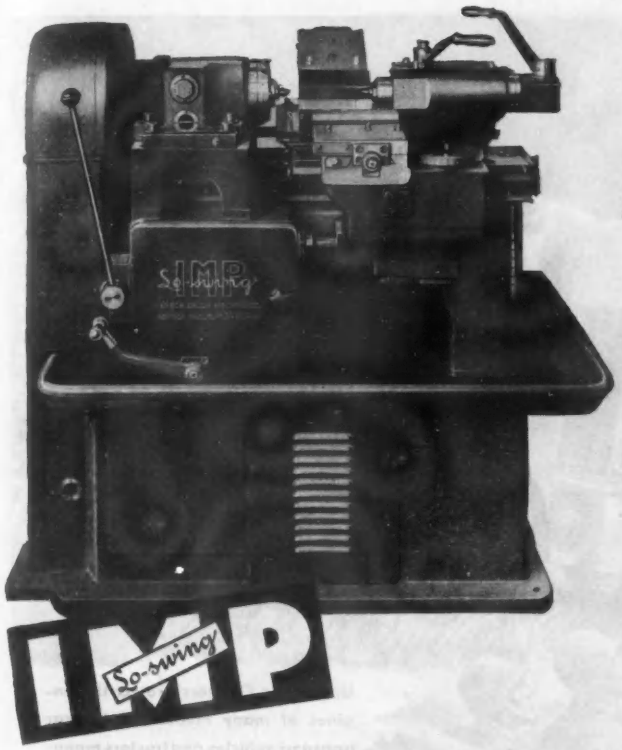

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FOR SMALL WORK DEMANDING HIGH SPEEDS AND EXTREME ACCURACY

The Lo-swing IMP Lathe lends itself to practically unlimited tooling possibilities. Illustration above shows a standard machine. The close-up views show three typical applications of standard and special attachments to the base machine which have resulted in increased production and lowered costs.

If you have a turning job requiring high speeds, fine finishes and extreme accuracy, write for IMP Bulletin N-42.

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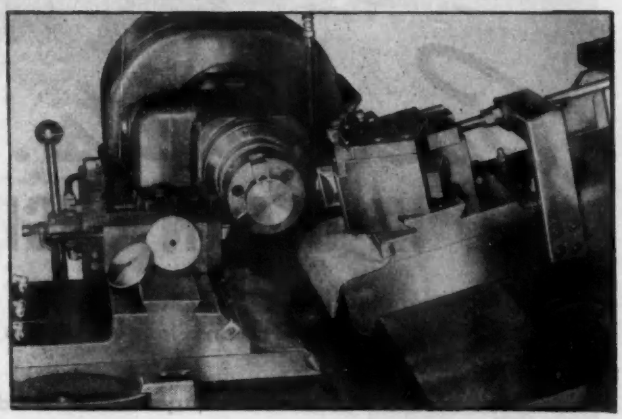
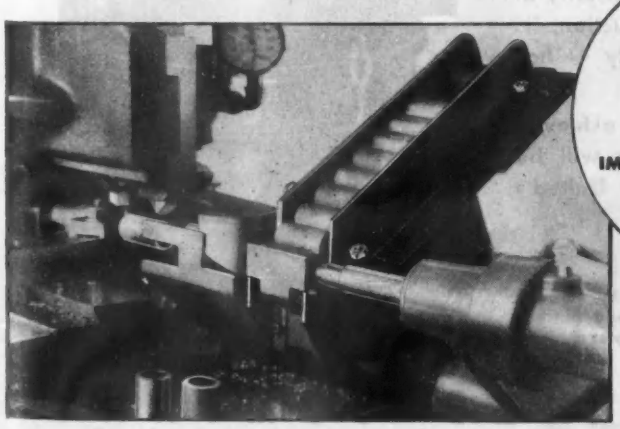
Seneca Falls, N. Y.

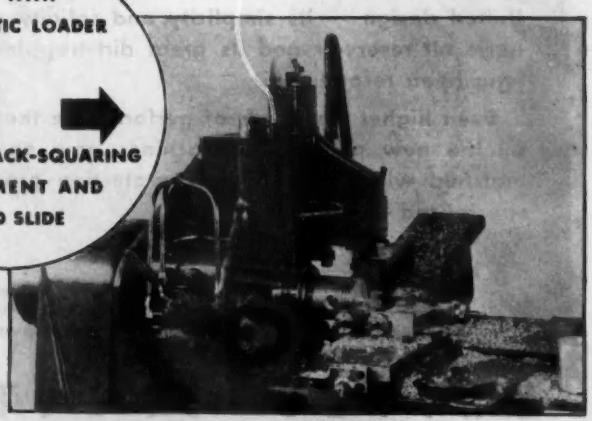


IMP WITH BACK-SQUARING ATTACHMENT



IMP WITH AUTOMATIC LOADER

IMP WITH BACK-SQUARING ATTACHMENT AND THIRD SLIDE



LATHE NEWS *from* SENECA FALLS

United Air Cleaners protect the engines of many models of Autocar transport vehicles and tractors manufactured for the Army and Navy.

Autocar Model No. 8144-T 5-6 ton 4 x 4 tractor truck, used for hauling ponton sections, is equipped with United Air Cleaner T195-12100 illustrated here.

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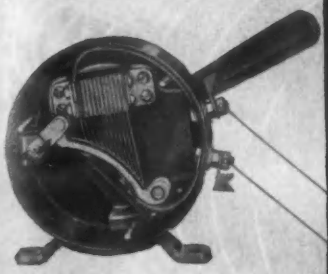


Why Warner Electric Brakes Give You SPLIT-SECOND STOPPING POWER FOR YOUR HEAVY LOADS

—USE LESS CURRENT THAN A TAIL LIGHT!

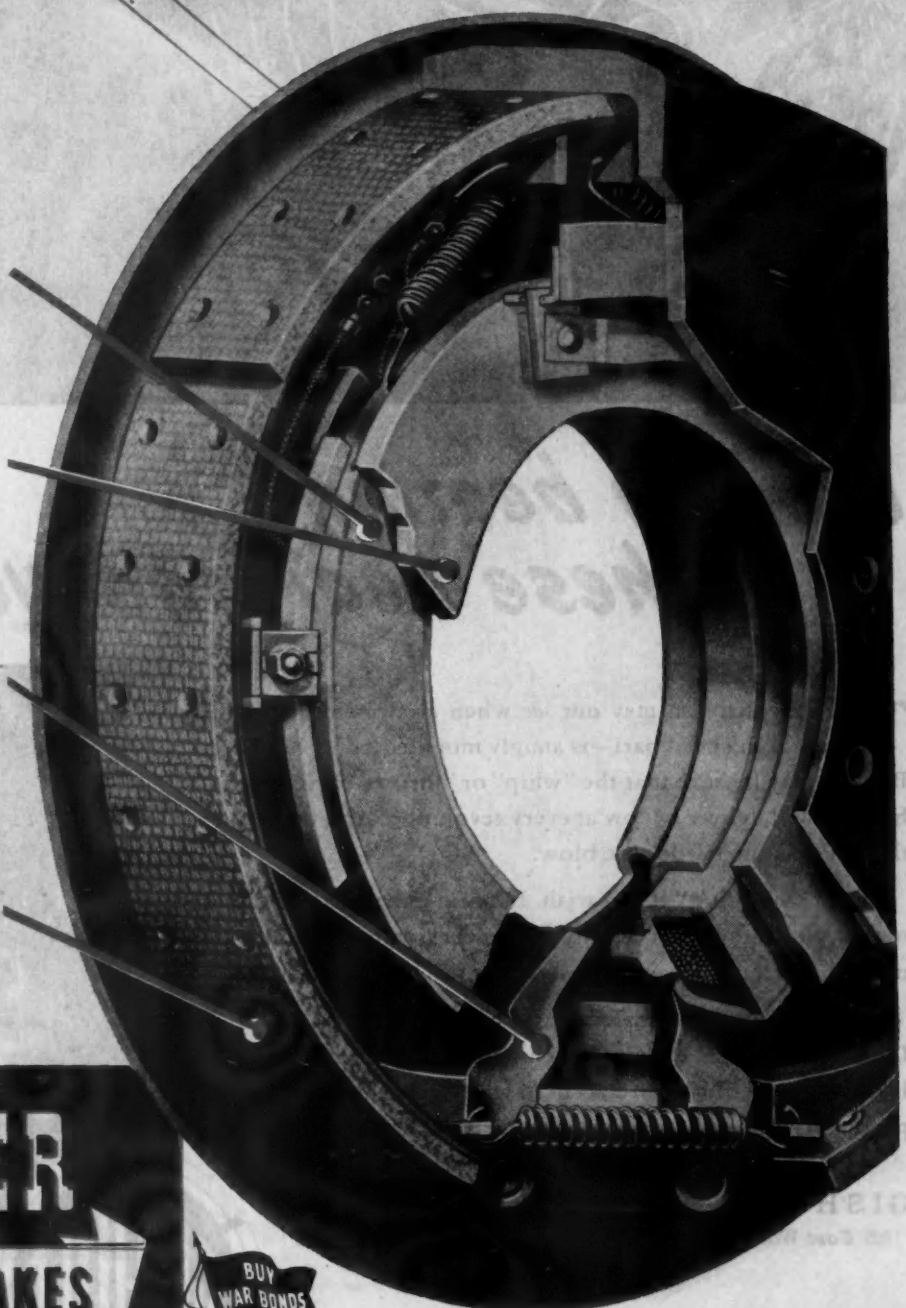
• The Warner Electric Brake is a simple, mechanical brake, operated by an electro-magnet and armature disc. Each wheel is a complete brake unit. The power is built within the brake itself — a wire to the battery and a rheostat control are all that is needed to operate the brakes.

• The electro-magnet remains stationary within the wheel, until power is applied from the driver's seat.

• The armature disc revolves with the wheel. When the driver moves the controller lever the electric current energizes the electro-magnet causing it to cling to the revolving armature disc which shifts the magnet within a limited arc in the same direction as the wheel.

• As the electro-magnet shifts, a lug attached to the magnet presses a cam against the brake band end, forcing the brake band against the drum thus applying the brake.

• The more current the driver allows to reach the electro-magnet the tighter it clings to the armature disc. A slight slipping action prevents grabbing. No brake adjustment is necessary. Lining can be worn down to rivet heads — at which point a safety stop eliminates scoring of drums.



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WARNER ELECTRIC BRAKE MFG. CO.

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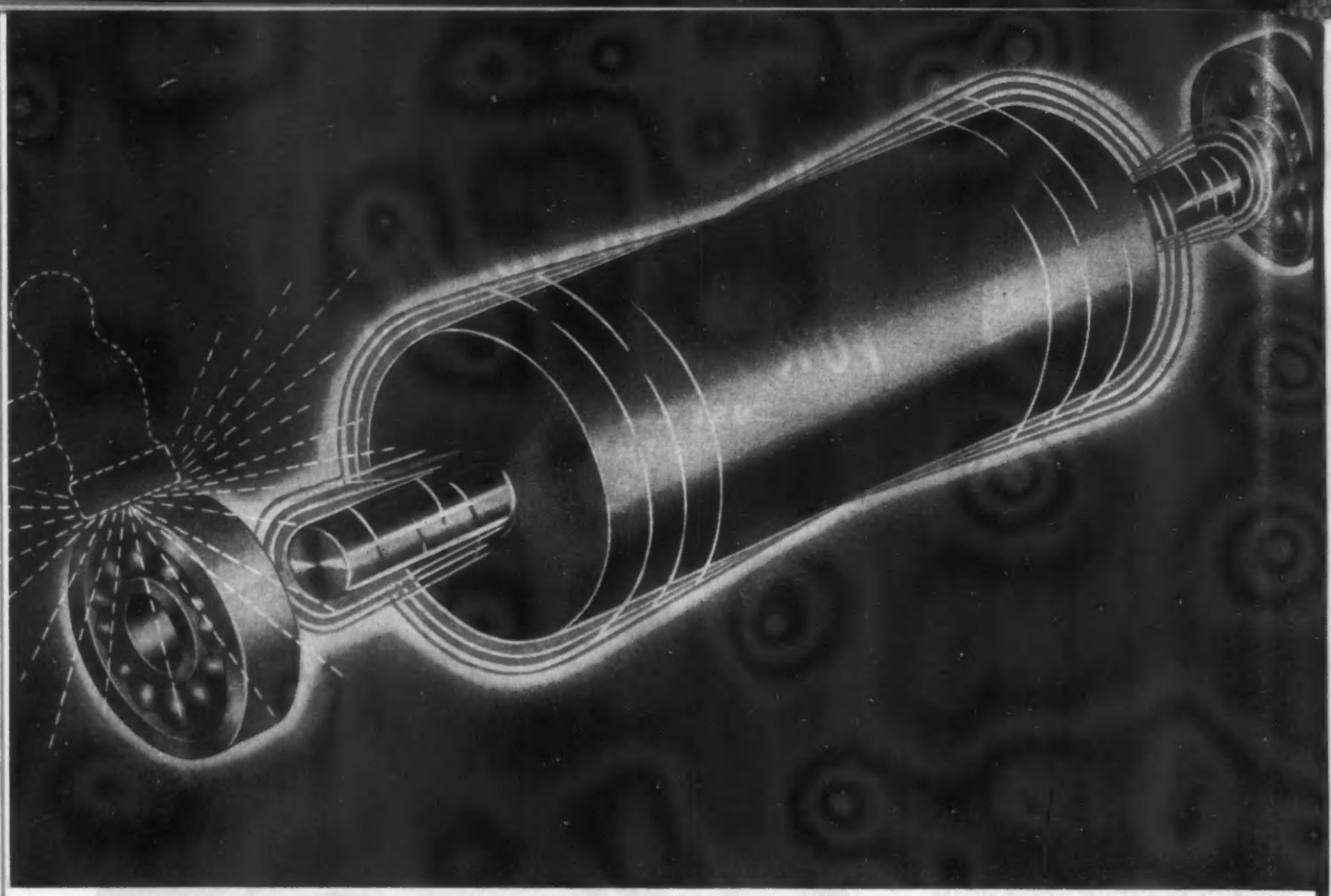

What a beating these bearings would take!

THIS is what you may not *see* when an armature—or any other high speed part—is snugly mounted on its bearings. But you may be sure that the "whip" or "throw" caused by unbalance will deliver a blow at every revolution. And the higher the R.P.M., the harder the blow.

Call it "vibration" if you wish. But remember that vibration means punishment for any high speed assembly . . . punishment that strains, wears, and shortens the life of vital parts.

To eliminate this unbalance and vibration is the job which Gisholt Dynetric Balancing Machines accomplish more quickly, more easily, and more accurately than ever before. If your product can be improved by it, write for full information.

DYNETRIC BALANCING first enables you to *locate* the point of unbalance; then *measure* it for accurate correction. Electronic tubes amplify unbalance vibrations as much as 1,600,000 times.

GISHOLT MACHINE COMPANY
1205 East Washington Street • Madison, Wisconsin

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Look Ahead . . . Keep Ahead . . .
With Gisholt Improvements

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES • SPECIAL MACHINES

Here's a great small spotwelder that is

★ *sturdy...*

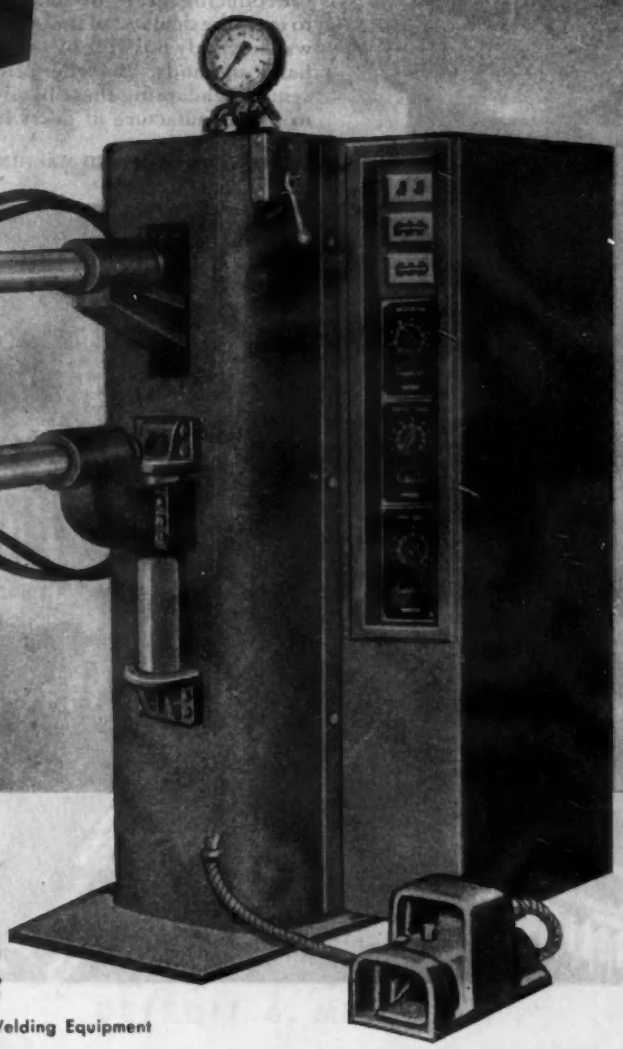
★ *precise...*

★ *fast...*

★ *compact...*

SCIAKY engineering has proved that it is possible to make a machine that is small, yet capable of delivering fast, high quality spot welds in day in and out production. Incorporated in this rocker arm type welder are exclusive features hitherto only used in larger machines. The use of heavy duty roller bearings at the fulcrum point of the arm, together with a special rubber cushion in the pressure cylinder, assure smooth action . . . eliminate hammering and wear. The design is compact with controls and contactor in a hinged cabinet . . . dials are convenient to operator and unit may be easily installed or moved.

If your problem involves the fabrication of mild, stainless or zinc-coated steels and brass in light gauges, it will pay you to consider the "PMCR.0-1."



MODEL PMCR.0-1

Rated 30 KVA at 50% duty cycle for power supply of 440 or 220 volts, 60, 50 or 25 cycles. Capacity: clean mild steel from two thicknesses of .016" up to and including .080"—stainless steel up to a maximum of .040" plus .040". Speed on two thicknesses of .032" thick pickled mild steel is 180 welds per minute. Maximum electrode pressure at 24" throat depth is 1000 lbs.

Write for descriptive bulletin No. 112-A

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As engine horsepower has gone up—and up—and up, engine manufacturers have demanded gears of greater compactness and greater precision to carry these vastly increased loads.

Producing gears of sufficient accuracy to meet the demand of these super-engines was formerly possible by slow and tedious hand methods. But the problems presented in adapting these hand procedures to the manufacture of gears in quantities sufficient to power the world's greatest air force meant a new approach to gear production.

The thousands of Pratt and Whitney engines in use in every theater of the war testify to the successful solution of these problems. For today, in the plants of Foote Bros. Gear and Machine Corporation, revolutionary methods of gear fabrication, heat treatment and quality control are assuring our air forces of high precision gears—in quantities.

Translated into terms of peacetime production, these gears promise American manufacturers new economies in power transmission—new compactness in machine design.

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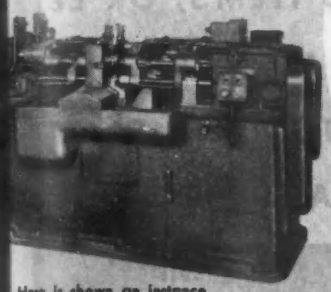
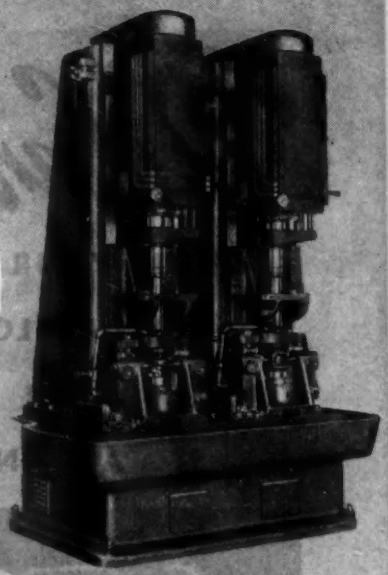
Better Power Transmission Through Better Gears

XLO

EX-CELL-O *for* PRECISION



Here is shown an instance where the Ex-Cell-O Small Hydraulic Unit (Style 21) is used on a machine for the accurate drilling of holes in oil pump bodies.



On this Ex-Cell-O double drill press, two Style 25-A Ex-Cell-O Hydraulic Units are mounted on the columns in vertical position. This has definite advantages on certain classes of work.

Plan Now for ECONOMICAL PRODUCTION!

Production Machines equipped with Ex-Cell-O Hydraulic Units have numerous advantages

For the machine you build, or the machine we build, the use of Ex-Cell-O Hydraulic Power Units provides these features:

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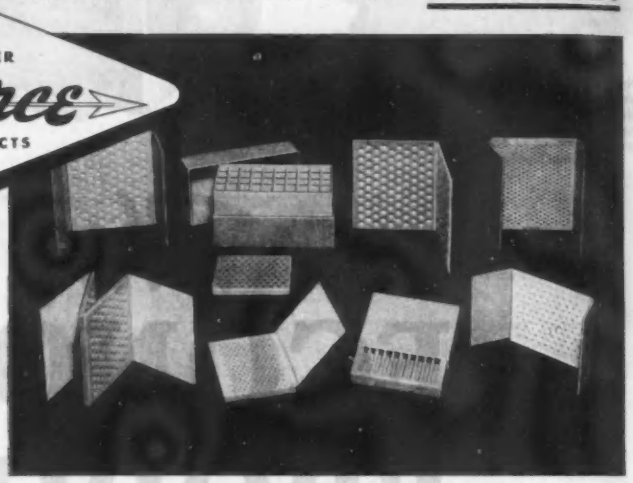

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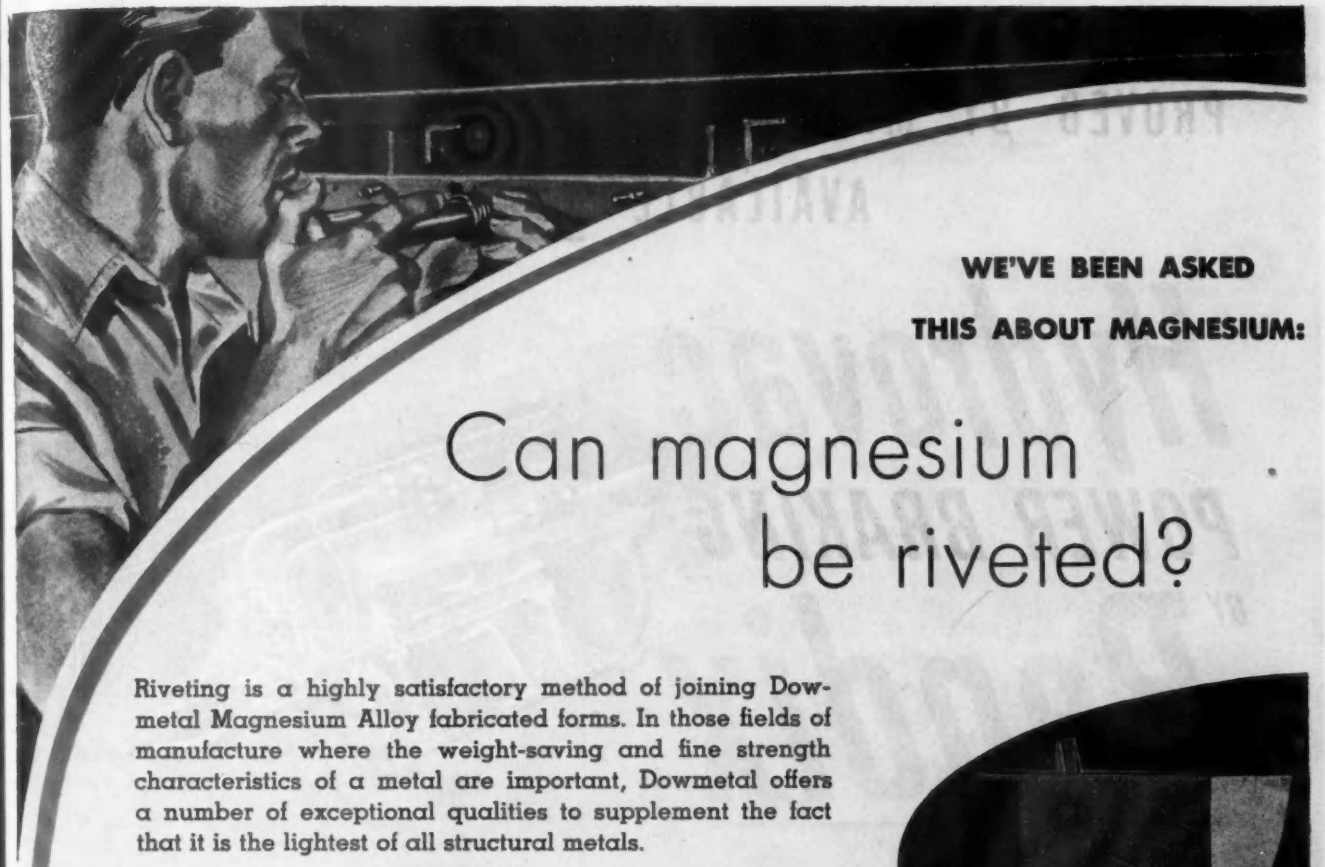

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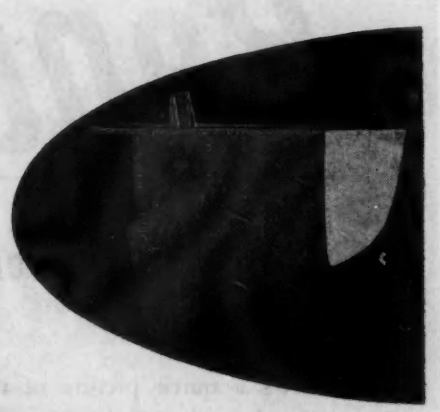

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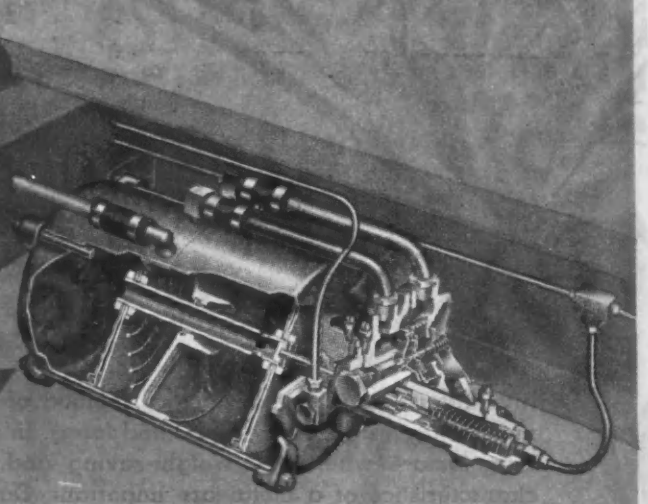

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In design, the Hydrovac power braking unit is small, compact, and completely enclosed against dirt and water. *In installation,* the unit is simplicity itself. It can be located any place on the chassis as the mounting brackets are never required to withstand loads due to reaction from brake applying forces. There are no external levers, and only three tubing connections are needed. *No adjustment* is necessary either at installation or later in service.

That's good news, and here's more: Hydrovac power braking is available *right now* to qualified wartime users! Check over the list of important advantages at the right, judge its exceptional worth for yourself—then see your Bendix B-K dealer, or write the factory direct.

- √ A normal "feel" or reaction on the brake pedal allows the driver to sense the exact degree of brake application or release.
- √ Instantaneous brake action is accurately graduated in response to the exact degree of pedal operation by the driver.
- √ No external levers, links or other mechanical moving parts.
- √ All working parts are within the Hydrovac braking unit, where they are protected from outside dirt and water.
- √ No reaction loads on mounting brackets—all stresses are taken internally.
- √ Extremely easy to install; may be located at the most convenient place on the vehicle chassis.
- √ The controlling force from the brake pedal is automatically added to the force of the power cylinder.
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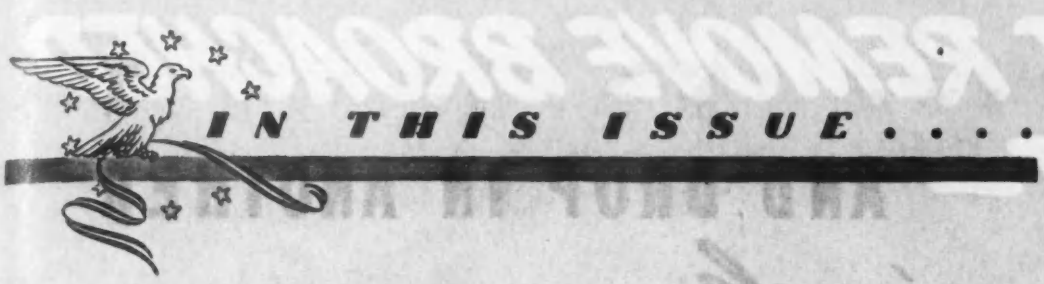


AUTOMOTIVE and AVIATION INDUSTRIES

Volume 91 August 1, 1944 Number 3

Plant Clearance to Speed Up Recoveries 17

A great big job is staring the industry in the face before conversion to peacetime production can be resumed. It is going to take a lot of high voltage planning. Here are some high voltage thoughts and an enlightening analysis that will make you think. Read this article.

An Air Power Policy For America 20

This country has put a lot of planes into the air in this "all-out-war" effort. The balance of power is being decided in the air. After the war the whole world will have become "air conscious." The future of America's safety, its industry and economic welfare depends on "what we do about it." Here are some real suggestions from the fountain head of authority in things aeronautic.

Gas Turbine Development— Past and Present 26

Here is a treat for you engineers from our old friend P. M. Heldt. You have read his articles for years in AUTOMOTIVE AND AVIATION INDUSTRIES. They need no introduction. They are sufficient unto themselves. Read this one too.

German Aerial Torpedo 31

Gradually the whole story has come to the front about this mysterious Nazi weapon. Here is the last that has come to hand from our British representative. It about washes up the whole package of details that have been subjects of guessings.

Copper Brazing 32

In this article the author brings to light some new techniques in the use of the conveyorized copper brazing furnace in general production setups. It shows another step forward in our methods, so read it and be posted.

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

A Time for Industrial Leadership

by Alfred P. Sloan, Jr.

OUT of today's tremendous accumulation of purchasing power, out of our present tremendous demand for all kind of goods, arises a question and a very important question. It involves a set of circumstances which we have never had before and which will not be duplicated certainly within the time of any of us now grown to maturity.

That question is this: Would it be possible, if American industry stepped forward and planned boldly and dramatically and with courage, and expanded its capacity and operations, to take care of this postwar demand, to capitalize this purchasing power? Would it be possible from an economic point of view to raise the national income, and hence, of course, the standard of living, to an amount far in excess of what we have ever had before?

I think that this is economically sound? I believe that it would be possible if industry would step forward, show the leadership, and take the risk, recognizing that perhaps the risk is not so great as the risk of not doing it. Naturally, the elasticity of the demand for various products must be measured as industry plans for this great opportunity and moves up to the extent that circumstances justify.

On a basis of conviction and faith, it seems possible to do it. The conviction is that it is possible, if we go along together, to meet the issue of postwar jobs and to raise the national income to a higher level than we have ever known before. Faith enters through a firm belief that, as a result of experience in the war, the attitude of the American public is completely changed with respect to industry and industry's problems and recognizes now the vital effect of industry's well-being on that of the country as a whole.

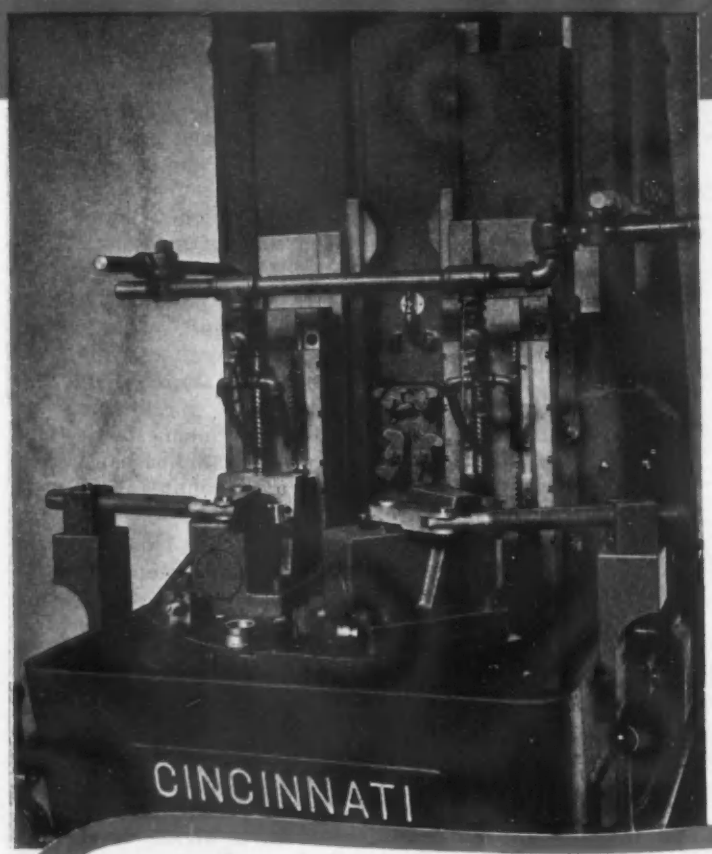
The rabbit-out-of-the-hat business, the something-for-nothing, the destroying of wealth on the false theory that by doing so we increase wealth, the idea that money is value in itself without regard to what it is exchanged for—all that and a lot of other panaceas that might be mentioned were characteristic of the 1930's and are finished.

I believe the American public is going to demand something different, irrespective of what happens in the Fall. I believe we can look forward to the postwar period with that conviction.

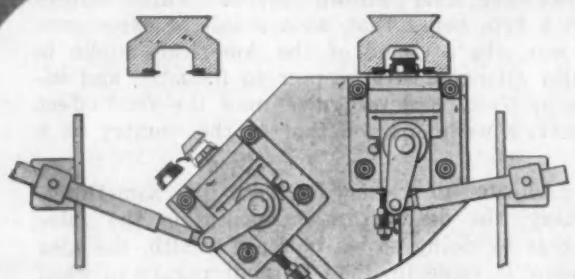
JUST REMOVE BROACHED PART— AND DROP IN ANOTHER

it's as simple as that

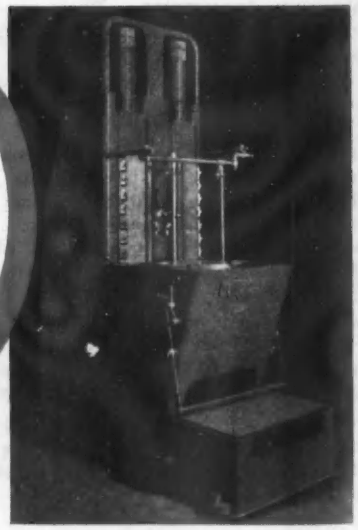
NO HAND CLAMPING OR MANUAL LOCATING REQUIRED WITH THIS CINCINNATI ENGINEERED EQUIPMENT



The exceptionally high production on this job, and the ease with which it was handled, may be attributed largely to the efficient fixtures designed by CINCINNATI Application Engineers. The equipment: A CINCINNATI No. 3-30 Duplex Vertical Hydro-Broach with automatic clamping fixtures. The operation: Broach two wrench slots. The operator simply removes one finished part and drops in a new piece to replace it. This is the only manual part of the entire operation. A V-block with a back taper locates the part centrally, and a cup-shaped clamp at the front of the fixture clamps the part back against a locating plate. ¶ This setup was developed by CINCINNATI Application Engineers and provides a fast and economical means of machining two wrench slots in a circular part. Talk over your broaching or milling jobs with our engineers. They may be able to work out a more satisfactory method of handling your work.



Simplified drawing showing how the parts are automatically located and clamped, prior to the down stroke of the ram.



CINCINNATI

Right: CINCINNATI *No. 5-42 Duplex Vertical Hydro-Broach. Catalog M-894-2 gives complete specifications. For a brief description, look in Sweet's Catalog File.*

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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

August 1, 1944
Vol. 91, No. 3

Plant Clearance—

What must be done to speed up recoveries

By George Romney

Managing Director, Automotive Council for War Production

PLANT clearance is a major physical undertaking in the reconversion of the automotive industry. It must precede any re-establishment of automobile manufacture and employment. The size of the task and its many aspects indicate need for analyzing the job before starting it.

The necessity for close scheduling of each of the phases of plant clearance is made obvious by consideration of the substantial amounts of time required to take inventories, have them checked, segregate various types of machines and materials, reach decisions on scrapping, packaging and storing, selling surpluses, arranging the handling and transportation, and actually moving the goods. Because of the time factor and the urgent need for definite action, it is apparent that any work done on this job before termination day will be a substantial contribution to prospects for quick reemployment of workers and war veterans.

From the viewpoint of the operating man in this industry, the immediate problem of plant clearance after termination can be best pictured by realizing the size of the physical task facing each of the various automotive companies. For example, one automotive company will have to move 100 acres of equipment, including huge presses, out of its plants in order to make room for reconversion to civilian production. Another automotive firm's job of unscrambling its facilities after the war involves Government-owned machinery covering 2¾ million sq ft and mingled with company-owned equipment. These machines must be segregated and moved before the firm can really begin its reconversion. In this case the machinery would cover a floor area equivalent to 25 Yankee Stadiums.

Some paper work and considerable organization are essential before Government-owned surpluses and equipment can be moved, but the present lack of clearly defined Federal procedures for the orderly disposal of this material is a major shortcoming in existing reconversion legislation. Even now—as the result of production cutbacks, contract cancellations amounting to $14 billions to date, and design modifications on war products—mountainous piles of obsolete parts, scrapped manufacturing equipment and idle raw materials are beginning to clutter up valuable manufacturing space. In an industry where plant space is always closely calculated, the situation now developing is paradoxical, for the whole automotive assembly system is built around the even flow of materials into the plant as needed. There never has been room for maintaining surplus inventories, and usually not more than a day's supply of one item or a week's bank of another was kept on hand. Today, materials which no longer are needed for war production and have no relationship to those used in automobile manufacture are cluttering aisles, crowding shipping docks, and clogging usable factory and warehouse space.

As an example of this condition, one automotive company has as much as 30 acres of space, both indoor and out, currently occupied by parts and materials from a cancelled tank contract. The original production schedule under the contract called for delivery of 7040 vehicles, but after 2728 had been manufactured, operations were ordered stopped. Left from the contract were 13,783 tons of high grade steel valued at $758,065, or about $55 a ton. When all plans to dispose of the entire lot failed, invitations were sent to 7000 steel users asking for bids on the material, item by item, and approximately 5503 tons were disposed of over a period of several months at an average price of $48 a ton. The remainder of the steel is tying up space in the company's yards, nearly

10 months after it became a surplus commodity.

In other categories, the company found itself with a large inventory of specially designed machine tools, jigs and fixtures, and precision gages and measuring instruments. Outside of machine tools, only a small percentage of the equipment was found to be usable on other war production work and none will be adaptable to motor car manufacture. Since the conclusion of the contract they have been boxed and placed in warehouses and yards. Among the surplus items are 2691 jigs and fixtures with a value of $8,000,000; 4347 special tools such as drills, cutters and reamers with a valuation of $5,000,000; 14,285 gages and measuring instruments valued at $520,000. Similar facts were turned up on such items as machine tools, dies, foundry molding equipment, and even partially fabricated tank parts. In this group there were 1518 machine tools with an estimated value of $11,000,000; 1200 metal dies costing $2,500,000; 2063 foundry items worth $4,000,000; and 923 completed tank parts worth $12,000,000.

Emphasis must be given to the idea that, if physical removal of Government property is required, the procurement agencies and industry must organize for the job now. Shortening the time requirements and reduction in the over-all size of the job can be accomplished by the 13 methods listed in the following paragraphs. Noted in each instance is the progress (printed in italics) made to date.

1.—Termination Policies

Carry through the plan to establish Governmental termination policies now.

Legislation has been pending in both branches of Congress for many months. Action is necessary now, in this session of Congress. The Government cannot afford delay in view of current cutbacks and cancellations. This is primarily a Congressional responsibility.

2.—Working Procedures

Procurement and disposal agencies should develop and test working procedures immediately by means of applying the procedures to current handling of cutbacks and cancellations. Case histories will help to determine whether the mechanism for contract termination is workable.

These must be free of red tape and designed to reduce the time requirement. Procedures can be evolved from experience in handling recent cutbacks and cancellations. Some procedures already evolving through PR-15. Further development immediately is the responsibility of procurement and disposal agencies.

3.—Training Personnel

Train Government personnel to carry out procedures and policies for rapid clearance of plants.

Some procurement agency personnel and industry personnel being trained now. Government should survey the requirements to make certain that the numbers available from procurement offices are sufficient to work out the details with all plants quickly.

4.—Paper Work

Find out what paper work and physical movement of goods can be accomplished *before* termination day. Wherever possible start now on inventories, estimates, classifying equipment, segregating various types of materials, and scrapping useless materials. At least make specific and detailed plans for doing these things immediately after termination.

Great lack apparent here. Not enough impetus has been given this by any agency. Planning is still mostly in the stratosphere. Down-to-earth handling of this problem must start soon. Contracting agencies should be acting on some of these plant clearance problems now.

5.—Earmarking Machine Tools

Earmark machine tools and equipment. Whatever is to be retained for arsenals, or used for standby purposes, should be tagged now and arrangements made for removal and shipping. Equipment to be scrapped should also be tagged now. Machines definitely going into storage should be tagged, and handling and store arrangements made now. Machines that can be sold to manufacturers should be priced and offered for sale now, so disposal can get underway.

Failure to establish policies and price formulae for machine tools is one of the most distinct threats to prompt clearance of plants. Immediate tagging of non-saleable machines, plus the sale of others (to be retained on war work as long as needed) can be done in most cases before termination day. This will automatically shorten the time requirement and reduce the size of the plant clearance job. It will also substantially decrease the time required while waiting for deliveries, if new machine tools must be ordered from busy machine tool builders at later dates. The Surplus War Property Administration and War Production Board will be taking an important step if they pursue the policy announced on June 12 by Mr. Byrnes, director of the Office of War Mobilization, to permit contractors to purchase Government-owned machine tools in the immediate future and to place orders for new machines that will be needed. Such arrangeemnts are imperative to prepare the American economy for rapid resumption of peacetime production and employment. These steps have been recommended by the industry on numerous occasions. Recent conferences have been held with Mr. Clayton and his associates.

6.—Designating Facilities

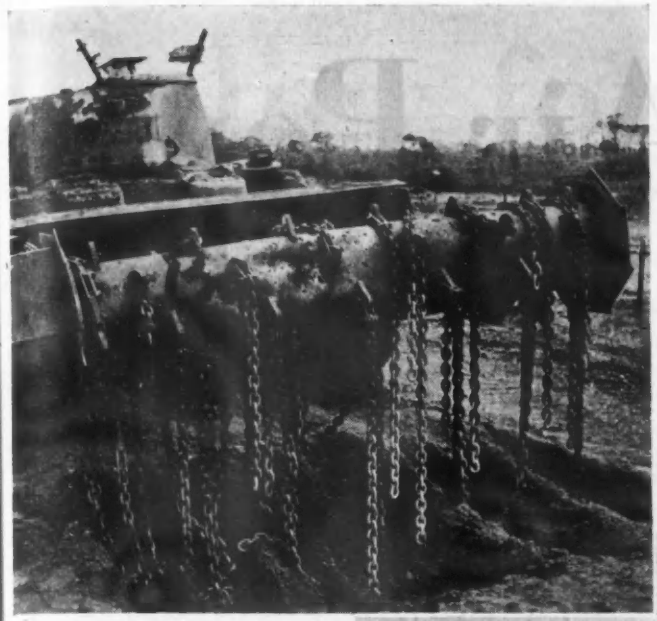
Procurement agencies and WPB should indicate as soon as possible what facilities will be kept in operation indefinitely; which ones will be kept in partial operation; which ones will be kept intact as standby plants, and which ones will be permitted to reconvert, partially or completely. Where possible, remove long-term contracts (aircraft and Navy, for example) from necessary civilian plants and concentrate them in plants where reconversion is not a factor.

By removing from preliminary consideration those plants which the Government desires to retain, the size of the plant reconversion problem will be reduced and the whole problem will be clarified. Industry will know then whether any new

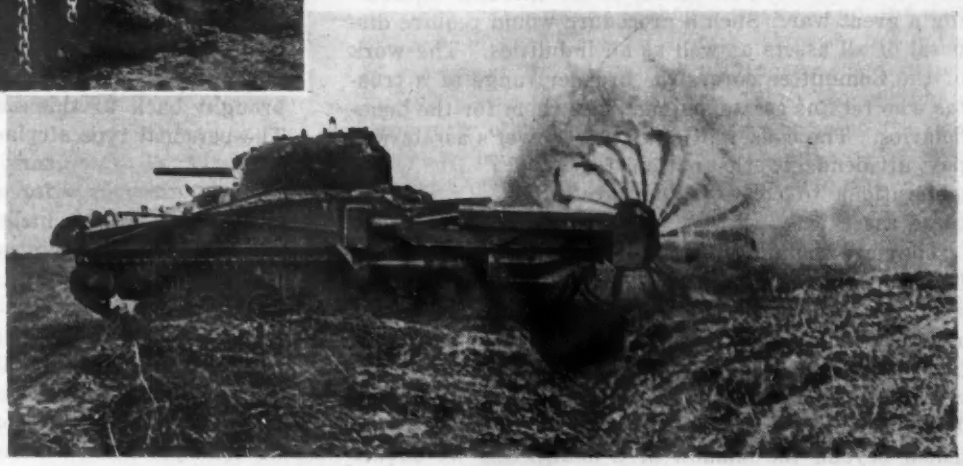
(*Turn to page* 148, *please*)

Flail Tanks Clear Minefields in Normandy

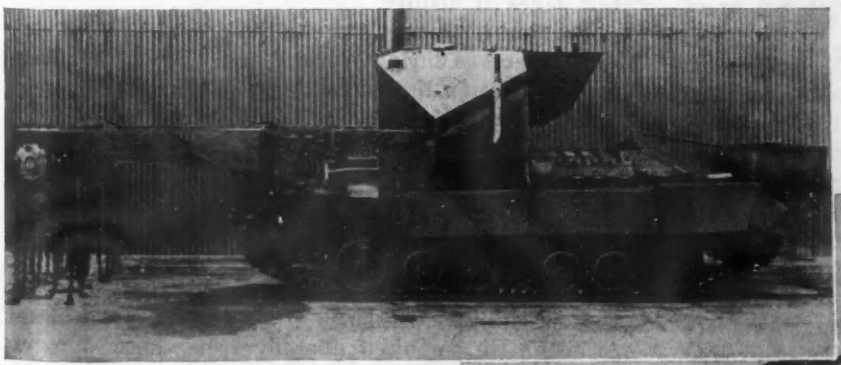
British Combine Photos



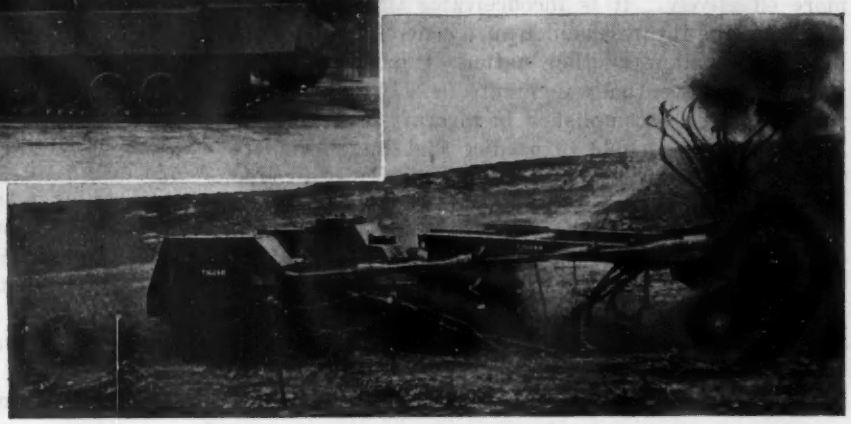
(Above) Fitted to the Sherman flail tank is this steel cylinder, to which is attached a number of lengths of chains. As the tank moves forward, the cylinder revolves and the free ends of the chains beat on the ground continuously. This flailing explodes anti-personnel and anti-tank mines.



(Above) This photo shows the latest flail tank model in operation. It is called the Crab and comprises an American Sherman tank with flail mechanism which is added at British factories. They are now being used to clear tracks through minefields laid by the enemy in Normandy. Flails of the Crab are driven by the tank engine instead of by an auxiliary engine as on the Scorpion flail tank.



(Below) Further development work with flail tanks resulted in the Baron, followed by the Marquis, and later by the Crab, which is shown on this page. The Baron tank (above) has a Matilda tank chassis.



(Above) The British first used Matilda and Valentine tanks with flails during the North African campaign, one of the latter flail tanks being shown above. These tanks were called Scorpions.

An Air Power

By Eugene E. Wilson

Chairman of the Board of Governors, Aeronautical Chamber of Commerce of America; and Vice Chairman, United Aircraft Corp.

THE objective of an Air Power policy is "to provide for the common defense, promote the general welfare and secure the blessings of liberty to ourselves and our posterity." We believe that historic, economic and all other considerations make such a policy imperative.

The details of the American Air Power policy are of importance to the present hearings because your Committee is not just acting as an executor liquidating a great war. Such a procedure would require disposal of all assets as well as all liabilities. The work of the Committee covers the broader range of a trustee who retains assets and manages them for the beneficiaries. The conservation of Air Power's assets will pay dividends to the nation for generations to come. What are these assets?

They are the planes which have bombed, strafed, torpedoed, and shot out of the skies the enemy aircraft in combat. More than that, they are the "know-how" which made these planes possible. The vital character of military air force is now established beyond the shadow of a doubt, and we should not heedlessly destroy the ability to produce such a potent weapon.

The success of the invasion of Europe hinged as much as upon any other factor on the ability of the air forces—working and fighting in conjunction with other services—to assure freedom of communications on land, sea and in the air for us, and to deny that fredeom to the enemy. We cannot afford to throw such advantages away by lagging behind in world aeronautical development either in time of war or of peace.

Naval Air Power has demonstrated in the Pacific that it controls the sea lanes. Planes have proved themselves not alone as new weapons, but also as a means for bringing old and new weapons together more effectively. It is inconceivable that we should now or in the future abandon such control and through indifference allow another nation or nations to outstrip us and eventually dominate us. In the light of what has been accomplished in aircraft manufacture, it is not unreasonable to predict that huge bombers will be able to attack an objective half way around the globe and return non-stop. We will not be allowed, in the future, the few hours of grace which follow a declaration of war. Air Power will strike like lightning. Announcement of hostilities will come later. We must have Air Power to discourage and forestall any sneak attacks such as Pearl Harbor.

While combat Air Power has proved itself, we must remember that American transport, too, has developed tremendously its utility as a war weapon. Private domestic airlines have expanded to operate vast overseas services under contracts with the Air Transport Command. The Army and Navy Air Transport Commands serve distant fronts in this global war. Rapid transportation of troops and key men have made possible complex operations—needed materials have been rushed to all fronts—war necessities have been flown back to our factories—wounded have been brought back to this country for proper treatment. The personal type airplane has made its contribution, serving as eyes for the ground forces, as the transportation vehicle for combat officers, and as an aerial ambulance.

Air Power has served so well in war that there is danger of its wartime accomplishments obscuring its peacetime significance. It is worth reminding ourselves that Air Power works for peace as well as for war, that air transportation—commercial and personal—is the heart of Air Power. Its backbone is the aircraft industry. Its sinews are the Army and Navy air forces.

With the coming of peace, some may protest that we cannot afford to maintain such Air Power after the war. This objection, however, loses sight of the fact that Air Power, properly administered, need not be a burden upon the people, tending to depress their standard of living but can, on the other hand, become a profitable investment. For proof, let us turn back a few pages of history.

The first important stage in the growth of American Air Power was during World War I. The development of our aviation at that time was thrust upon us by great external forces. Before that war, we did not regard the airplane as something to fight with; we thought of it as a tool for peacetime pursuits. At that time, surface transportation, and principally international sea transportation, was all-important, as it had been for centuries.

When we entered the war in April, 1917, we were without military airplanes or even designs for them. Although we borrowed liberally from the designs of our Allies, although we worked hard to produce designs of our own, and although we moved energetically to produce military aircraft by American volume production methods, few American airplanes were in combat.

Similarly, we were not prepared for the Armistice which came in November, 1918. We had no adequate plans for terminating war contracts. We had no

This statement was presented in July by Mr. Wilson to the War Contracts Subcommittee of the Committee on Military Affairs, United States Senate.

Policy for America

definite program or facilities for disposition of surplus goods and plants. The result came close to a debacle when many aircraft companies failed and those which escaped collapse were producing only a few small orders.

In 1925, the vigorous criticisms of Brig. Gen. William E. Micthell and a mounting public demand resulted in the creation of the "Morrow Board" by President Coolidge. This was composed of representatives of the Armed Forces, the aeronautical engineering profession, Congressional bodies and the public.

The recommendations of this board, embodied by Congress in the Air Corps Act of 1926, resulted in the appointment of an Assistant Secretary for Air in the Departments of War, Navy and Commerce. The board concluded that our national security required a strong air force and that at its base there must be a sound private aviation industry whose technological and manufacturing progress was to be made possible by an extended program of procurement.

The Morrow Board and its recommendations might well have started the United States on the road to real Air Power. Not all its recommendations were followed. Some were. Sometimes they were followed consistently and sometimes intermittently. But even this prepared the basis for America's aircraft industry to be technologically prepared for the requirements of World War II. We had the designs, if not the plants and the production.

Fortunately, orders from nations which were later our Allies, enabled us to take our designs, build up our plants, and develop our production so that at the time America entered World War II we were in a position where we could supply aircraft to our Allies, instead of borrowing from them, and at the same time build up our own nation's air forces. The moral of this is future Air Power preparedness.

Control of communication by sea is a counterpart to Air Power. Captain Mahan's work, "The Influence of Sea Power Upon History," showed the effect of sea power in successfully waging war and in promoting prosperity during peace. The cooperation of American and British sea power brought the constructive benefits of a peaceful interchange of products and ideas throughout the world.

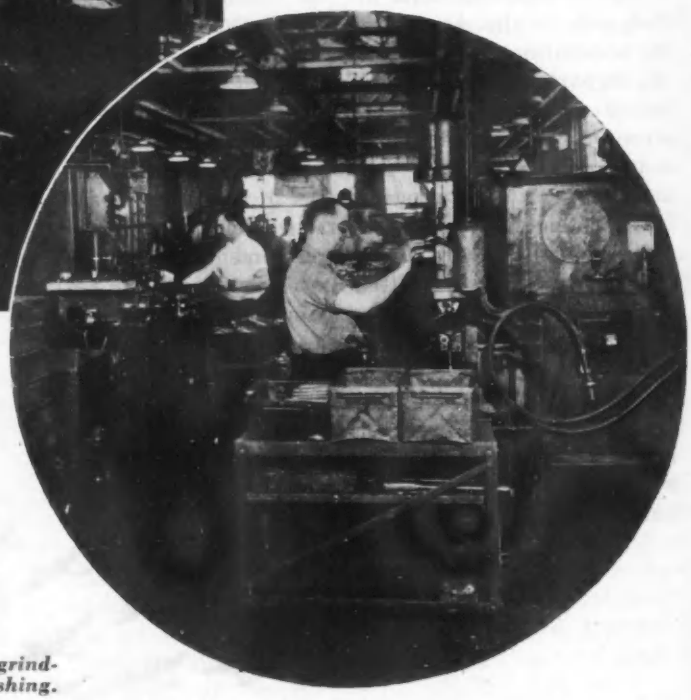
Three times during the past 25 years this beneficent control of the seas has been challenged by the enemies of democracy—twice by the Germans with submarines and recently by the Japanese with naval Air Power. But Allied Air Power in conjunction with greatly expanded naval forces have met these menaces.

(*Turn to page* 80)

An investment in Air Power will pay rich dividends in future security, economic progress, employment, and in the broad advance of our civilization

Gabriel Products

(Below)—In the shock absorber assembly department — in the foreground are the National projection welders. This equipment is used for the various welding operations outlined in the routing.



(Above)—Many of the stamping operations in the press shop are designed for high productivity. Typical of these is the equipment in the foreground, showing the use of a progressive die with motor driven stock reel, and a Wittek feeding roll at the right.

(Below)—A battery of Cincinnati Centerless grinders and lapping machines for piston rod finishing.

LONG identified as a prominent manufacturer of automotive shock absorbers, The Gabriel Co., Cleveland, Ohio, has played an important role as a war producer. Gabriel Aerotype direct-acting shock absorbers are being produced in large quantity for application on jeeps, reconnaissance cars, and armored cars. In addition, a line of Gabriel hydraulic cylinders has been supplied for military aircraft application—for gun turrets, wing control flaps, and landing struts.

Late in 1943, Gabriel acquired the business of the International Metal Hose Co., now a division of Gabriel, and one

By Joseph Geschelin

on Military Vehicles and Warplanes

of the major suppliers of flexible metal tubing for a variety of applications. This product is being supplied as detachable nozzles for gasoline "blitz cans," for exhaust hose on jeeps, trucks, tanks, armored cars, etc. High pressure flexible metal tubing is used in the remote control systems of military vessels of the Navy and for merchant ships. In addition to these normal activities, Gabriel has been operating a special department for the volume production of 60-mm trench mortar shells and fins, using both forgings and steel castings for the bodies.

Significantly, the company has projected its thinking to an important postwar program which can be placed in effect at the cessation of hostilities. This contemplates an ambitious expansion and conversion project designed to provide facilities for the mass production of Aerotype shock absorbers for standard equipment as well as for the replacement trade. The line will consist of four basic types, encompassing a range of sizes suitable for passenger cars, trucks, buses, and for light cars of postwar design. Following the same pattern, flexible hose will be produced for automotive exhaust and heater tubing, for aircraft, for shipbuilding, for the petroleum industry, and for household appliances.

During the war, all of Gabriel's energies directed to the manufacture of shock absorbers, special struts for aircraft and other applications, and of shells and fins, are concentrated in the original shock absorber plant. This activity has been carried on without plant expansion and with the minimum of new equipment. To facilitate these operations, the plant has been departmentalized in the interest of maximum economy. Here will be found a comprehensive press shop with a variety of small inclinable presses; a large screw machine department fitted with four-spindle Cone automatics and six-spindle Gridley automatics; a machine shop for the shell bodies, equipped with a large battery of Sundstrand lathes; a paint department; machine shop for shock absorber parts; etc. Shock absorbers are assembled in a department provided with assembly benches and a variety of special tools and fixtures.

Although machine shop methods are conventional in character, Gabriel has developed a number of advanced techniques in resistance welding. They use Taylor-Winfield and National Welding machines, em-

This is the Ninety-sixth in the series of monthly production features

View of machine shop department for the 60-mm fin assembly with Kingsbury drilling machines in the foreground.

(Above)—Corner of the large machine shop for 60-mm trench mortar shell. In the foreground is a battery of Gisholt automatic lathes for turning.

(Below) — Unique Taylor-Winfield projection welding machine for the automatic welding, in one operation, of the fin assembly. Here the four stampings are assembled in a fixture and spot-welded in one operation.

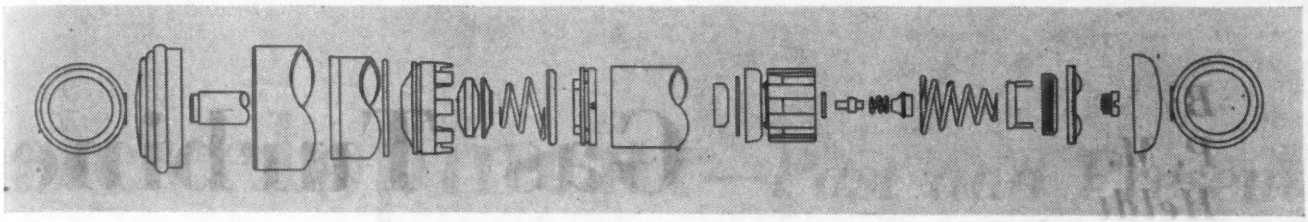
ploying projection welding techniques exclusively. In the manufacture of shock absorbers, for example, the process has been simplified by welding procedures. Shock absorber eyes are welded to a cup for one end; and are welded to the shaft for the other end. The end cups are seam welded to the tubing to provide a pressure-tight closure. One of the most outstanding of the welding developments, however, is the huge Taylor-Winfield projection welder in which the four U-shaped stampings are spot-welded to the body to form shell fin assemblies. This operation is performed in one setting with the pieces assembled and held in a special work-holding fixture.

Bodies for the 60-mm trench mortar shell are machined in Sundstrand lathes, using Kenametal-tipped tools. This special steel cutting grade cemented-carbide has been responsible for a tremendous increase in productivity and a corresponding improvement in finish. The machined parts are inspected on a bench, using a Sheffield Multi-chek gage for sizing, and by visual inspection at other stations.

Shock absorber shafts are machined from bar stock on automatics, then finished to fine tolerances and fine surface finish on a battery of Cincinnati Centerless machines — starting with a grinder and progressing through two lapping stages.

In the press shop, excellent procedures have been developed for handling long run stampings such as the parts of the 60-mm fin. The presses are fitted with progressive dies, the metal strip being fed through from the coil by means of an auto-

Blakeslee Niagara washing machine is employed for the cleaning of the 60-mm shells.



Exploded view of Gabriel shock absorber—Model "B."

matic reel attachment.

Production of shock absorbers is a highly mechanized operation laid out for straight line process from beginning to the final assembly and testing. Welding and high-speed spinning operations are employed exclusively to eliminate threading and fastenings in the interest of high productivity at minimum cost. All shock absorbers are dynamically tested on special presses to determine the conformity of characteristics of each one against a master cylinder. Calibration of the master cylinders is handled in the experimental department which also carries on an extensive program of research and development as well as trouble-shooting.

The paint shop is equipped for the finishing of mortar shells as well as shock absorbers. Thc shells are sprayed in Binks booths. Shock absorber assemblies are dipped in tanks, than baked in an infrared lamp oven. In keeping with mass production methods, wherever feasible, as in the paint shop and in the shock absorber assembly department, the work is handled on a monorail conveyor system.

It is of interest to find that the assembly of shock absorber units has been skillfully routinized into a smooth flow of operations within the self-contained assembly department. A typical sequence of such operations is given below:

1. Join cap eye by projection welding.
2. Assemble inner cylinder to cap assembly and seam weld.
3. Join eye to piston rod cap by projection welding.
4. Assemble small parts to piston rod; assemble piston to rod and stake.
5. Assemble adjusting screw to piston; adjust and stake.
6. Insert compression cage to cylinder, spin and swage permanently.
7. Assemble piston rod assembly into cylinder and spin over.
8. Fill with oil and insert filler plug.
9. Assemble cylinder sub-assembly into intermediate cylinder and spin together.
10. Dynamic testing of completed units to assure conformity with specified characteristics.
11. Install dust tube over assembly and spot weld in place.
12. Wash and clean; then paint.

The foregoing operations may be visualized by referring to the exploded view of a Model B shock absorber.

The International flexible tubing plant is one of the most modern of its kind. To the observer, the process is closely akin to that of a specialized spring winding plant with its seeming simplicity of operation. However, the secret of producing the variety of flexible tubing in the line resides entirely in the development of special machinery, designed and built by the organization. By an automatic cycle, the special machine takes in suitable coiled metal strip and spins the tube, which moves onto a long bench. In some instances the tubing incorporates an asbestos packing. This, too, is spun in automatically at the machine head, feeding from a spool of asbestos twine. On the long benches, the tubing is cut to length while it is moving, is suitably finished at the ends by hand and on machines, depending upon the nature of the application. High pressure tubing, in turn, is fitted with couplings and hydrostatically tested for acceptance.

The variety of tubing produced in this plant is

(*Turn to page* 150, *please*)

View of the final inspection bench for 60-mm shell bodies. At the right is the Sheffield Multi-chek, electric gaging machine, which inspects the gamut of important dimensions in one setting.

By P. M. Heldt

Gas Turbine

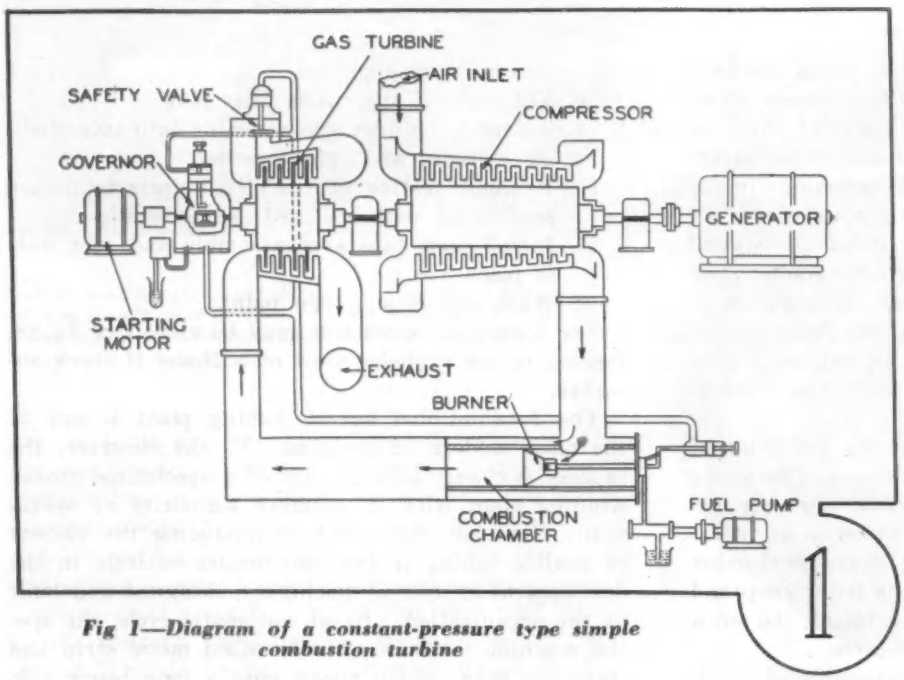


Fig 1—Diagram of a constant-pressure type simple combustion turbine

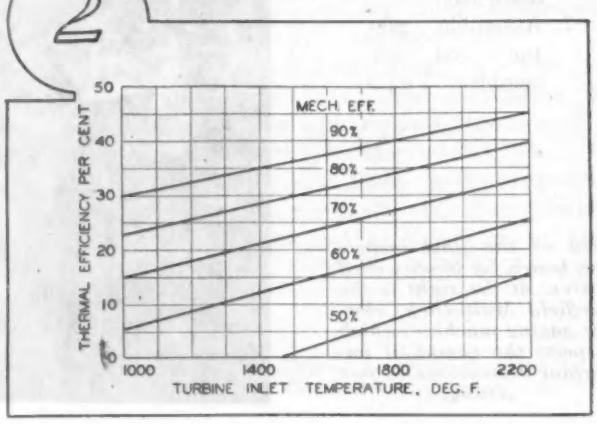
THERE has long been a widespread belief that, since the steam turbine was found to be more economical than the reciprocating steam engine and entirely ousted it from large installations, the gas turbine also would prove economically superior to the reciprocating internal combustion engine. However, in spite of the fact that much study and experimental work has been devoted to it, the gas turbine has made as yet only little practical progress. In the United States at the present time, so far as is known to the writer, it has only two specific fields of application, and it is a significant fact that in both of these fields it is being operated on what would otherwise be waste energy.

The first application is in turbochargers or superchargers, as used on aircraft engines and large stationary and marine Diesel engines. There the turbine is operated on exhaust gases, and though the back pressure on the engine cylinders may be slightly greater with the turbine connected than without it, the fact remains that the major part of the energy supplied is that which is normally "thrown away" with the exhaust. The other application is in the petroleum industry, where high-octane motor fuel is being produced by the Houdry catalytic cracking process. In the operation of this process, carbon is deposited on the catalysts and tends to "poison" them, and in order to restore them to their normal activity, the carbon must be burned off. This is accomplished by burning fuel in a closed chamber under pressure, and the combustion yields a large quantity of gas at high temperature and under considerable pressure. This gas is used to operate the turbine which drives the compressor that furnishes the compressed air required for the process. The cost of the fuel burned can be charged against the cracking process, and the turbine therefore operates on waste energy.

That there have been no applications of gas turbines in the transportation and central-station fields is due to the fact that so far it has been impossible, or at least very difficult, to obtain the same thermal efficiency from gas turbines as from other available prime movers. To explain the reason for this lower efficiency it will be necessary to briefly describe the operating principle of the gas turbine.

Like other heat engines, the gas turbine generates power by burning fuel. In order to convert the heat of combustion most efficiently, combustion must take place under pressure, and the combustion air or the combustible mixture therefore must be precompressed. In reciprocating engines the charge is al-

Fig. 2—Approximate variation of the thermal efficiency with the turbine-inlet temperature and the combined efficiency of turbine and compressor



Development—*Past and Present*

ways compressed before it is ignited, and we know that the higher the compression—within the limits set by detonation—the greater will be the output and the higher the efficiency of the engine. Therefore, a gas turbine must include a compressor for compressing air or mixture. Then, of course, there must be a burner (furnace or combustion chamber) in which the fuel can be burned and the compressed air raised to a higher temperature. The mixture of air and gases of combustion leaving the burner or combustion chamber corresponds to steam withdrawn from a boiler, and is admitted to the turbine proper. In the turbine the gases expand to near atmospheric pressure, and they are then discharged to the atmosphere. Fig. 1 shows a gas turbine of the simple type described in the foregoing. The net output of the turbine is transmitted through the direct-connected compressor and a reduction gear to an electric generator, and an electric starter is provided to bring the turbine up to about 25 per cent its normal speed, at which speed it produces enough power to accelerate without outside help.

We may now discuss the factors which limit the output and the efficiency of the turbine. The efficiency of any power generator is equal to the ratio of the difference between the energy supplied and the energy rejected, to the energy supplied. In the case of a gas turbine, if we operate at a constant pressure, the available energy varies directly as the temperature of the gases as they enter the turbine. For high efficiency, therefore, the gases must enter the turbine at the highest permissible temperature. However, a limit is set on this temperature by the ability of the materials of construction to withstand high temperatures. This applies particularly to the materials of which the blades are made, and with present blade materials such as stainless steel, a temperature of 1200 F seems to be the approximate limit, if the turbine is to have a commercially satisfactory life. For "stunts," or for peak performance of a few hours' duration, a turbine can be operated at as high a temperature as 2000 F.

Only a portion of the energy contained in the working fluid is converted into mechanical work in the turbine. The same as in the combustion engine, there are losses due to heat absorption by the casing and to heat rejection in the exhaust. The efficiency of the turbine also depends to a considerable extent upon the shape of its blades. The more nearly these approach smooth streamline forms, the higher the efficiency. The same applies to the compressor, which works on a principle similar to that of the turbine. Both generally are of the axial type, comprising alternate sets of stationary and rotating blades. In the case of the compressor, not only the losses therein, but the entire power consumed, represents negative work, and must be subtracted from the turbine output to arrive at the net output of the unit. In some of the latest designs the power absorbed by the compressor is equal to about two-thirds of the power output of the turbine. The efficiency of the compressor generally is of about the same order as that of the turbine.

Blades of modern axial turbines and compressors have the shape of airfoils (airplane wings). Considerable improvement in airfoil shapes has been made as a result of aerodynamic study and experiment,

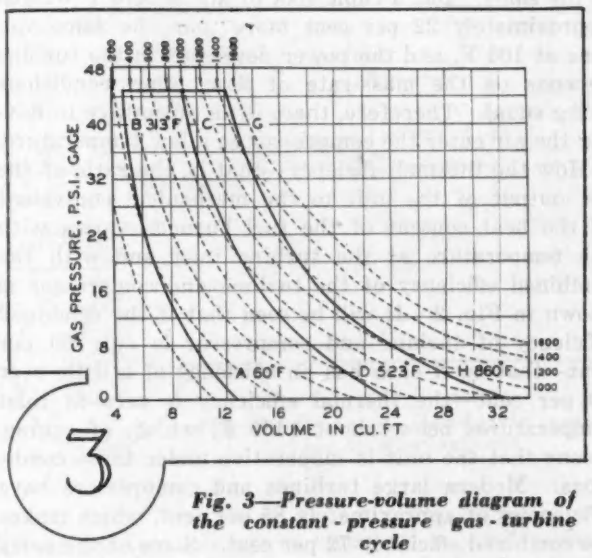


Fig. 3—Pressure-volume diagram of the constant-pressure gas-turbine cycle

and it is to be expected that the intensive aerodynamic research carried on in connection with the war will make possible further progress along this line. Research work is also being directed toward the development of metallic alloys of higher "hot strength," for use in aircraft engine valves, and there is a good chance that this will lead to the discovery of materials which when used in turbine blades will permit of higher gas inlet temperatures.

Reference was made in the foregoing to the power required to operate the compressor, which results in negative work. One of the basic principles involved is that the work required to compress a certain mass of air from a given initial pressure in a certain volumetric proportion is greater the higher the initial temperature. If we take a cubic foot of air at atmospheric pressure and compress it to, say, one-half a cubic foot, the energy required (or the work of compression) is the same whether the initial tempera-

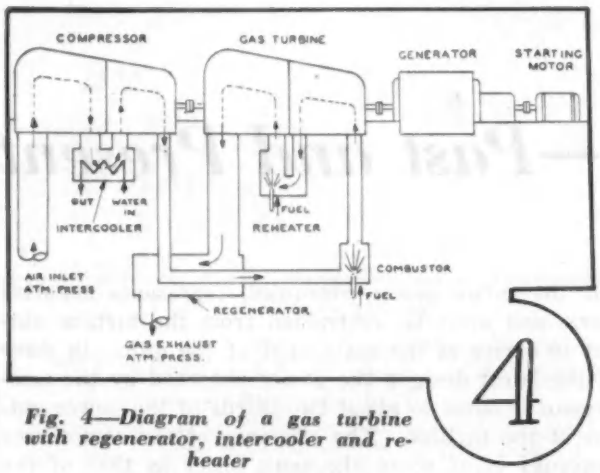


Fig. 4—Diagram of a gas turbine with regenerator, intercooler and reheater

ture of the air is zero or 100 F, provided there is no loss of heat during the compression. That this should be so can be readily understood when it is considered that both the initial and the final pressures are the same in both cases, and the change in volume also is the same. But a cubic foot of air at zero F weighs approximately 22 per cent more than the same volume at 100 F, and the power developed in the turbine depends on the mass-rate of flow, other conditions being equal. Therefore, there is an advantage in having the air enter the compressor at a low temperature.

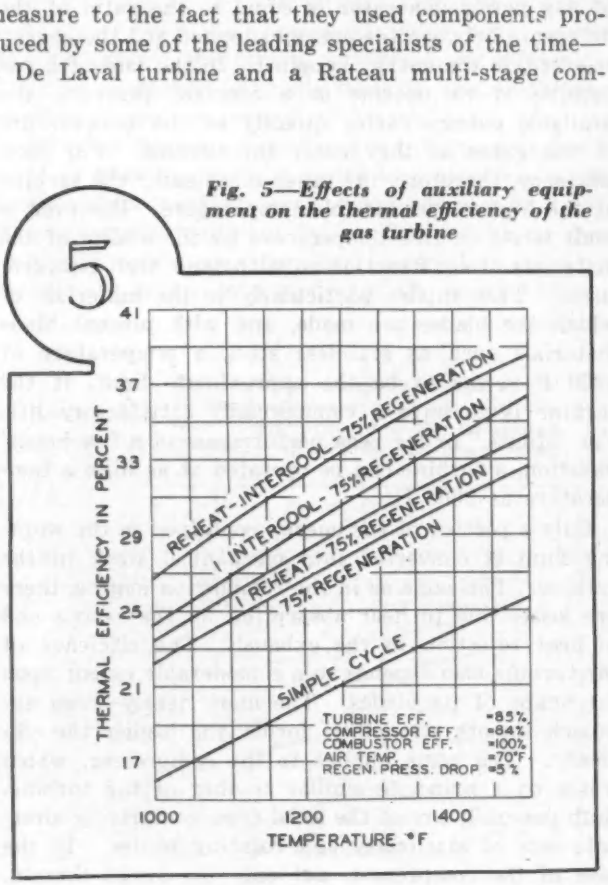
How the thermal efficiency—that is, the ratio of the net output of the unit to the mechanical equivalent of the heat content of the fuel burned—varies with the temperature at the turbine inlet and with the combined efficiency of the turbine and compressor is shown in Fig. 2. It will be seen that if the combined efficiency of turbine and compressor is only 50 per cent—that is, if each has an efficiency of a little over 70 per cent—the thermal efficiency is zero at inlet temperatures below about 1460 F, which, of course, means that the unit is inoperative under these conditions. Modern large turbines and compressors have efficiencies of approximately 85 per cent, which makes the combined efficiency 72 per cent. Some of the early experimenters with gas turbines used compressors with an efficiency of about 65 per cent, which explains why they got very little power, or none at all, even though their turbines embodied all the necessary elements. It will be seen from Fig. 2 that with an inlet temperature of 1200 F and a combined efficiency of turbine and compressor of 70 per cent, the maximum thermal efficiency which can be expected from the simple gas turbine here considered is about 18 per cent.

The gas turbine is not an apparatus of recent conception. That its principle was known at a relatively early date may be ascribed to the fact that a windmill is essentially a gas (or air) turbine. Conversely, we may think of the gas turbine as a windmill operated on artificial wind—of hurricane intensity. Ordinarily when there is need for artificial wind, as in movie studios, wind tunnels, etc., it is produced by motor-driven fans. That method, however, would not be applicable in this case. It would be like trying to raise hogs for the market on a pork ration—the yield would be less than the expenditure. To make the gas turbine economically possible, energy must be imparted to the working fluid by the combustion of fuel, and mechanical work must be done on the fluid only to the extent necessary to render the conversion of its heat into mechanical energy efficient.

The general principle of operation of the gas turbine as it is known today was first recognized more than a century and a half ago, and a British patent was issued to John Barber in 1791 on a gas turbine which incorporated all of the essential elements. However, there is no record of any one having built a successful turbine based on these principles until quite recently. Interest in gas turbines was revived as a result of the invention of the steam turbine by Sir Charles Parsons in England toward the end of the nineteenth century. In fact, Parsons made reference to gas turbines in his original steam-turbine patent. He explained that if the turbine were driven by an outside source of power, it would act as an air compressor. Parsons proposed to discharge the air thus compressed into a furnace, into which fuel would be injected, and to expand the gases of combustion in a turbine. He thus originated what is now known as the axial compressor, and his company built a good many such compressors, but it apparently never got around to building gas turbines.

The first gas turbine based on the general principles envisioned by Barber and Parsons, and developing appreciable power, was designed by Armengaud and Lemale, and built by the Société des Turbo-Moteurs in Paris during the first decade of the current century. These engineers achieved at least a technical success, which probably was due in no small measure to the fact that they used components produced by some of the leading specialists of the time—a De Laval turbine and a Rateau multi-stage com-

Fig. 5—Effects of auxiliary equipment on the thermal efficiency of the gas turbine



pressor. Air from the compressor was supplied to a combustion chamber, into which liquid fuel was injected, and the gases of combustion, after being cooled by water injection, were discharged into the turbine. The thermal efficiency was only about 3 per cent, and the machine was not developed commercially, but it served to create widespread interest in gas turbines. During the years immediately following, papers on the subject were read before scientific and technical societies both in Europe and in this country, and even two books were published in the English language, both bearing the same title—The Gas Turbine. One was by H. H. Supplee in this country, the other by N. Davey in England.

However, the great difficulty that would be encountered in any attempt to equal the thermal efficiencies of existing prime movers were gradually recognized, and some rather pessimistic statements or reports were issued by parties whose word bore considerable weight in the gas-engine industry at the time. For instance, a leading British gas-engine expert, Dugald Clerk, in a discussion before the Institution of Mechanical Engineers, said he did not see any immediate future for the gas turbine, except possibly in using the exhaust gases from reciprocating engines, which are liberated under considerable pressure. The writer also remembers that shortly after World War I the British Air Ministry issued a pamphlet containing a report on a study of the gas-turbine problem, in which the low thermal efficiency theoretically possible under then existing conditions was emphasized.

Toward the end of World War I the problem of supercharging aircraft engines was attacked. The earliest superchargers or blowers were driven directly from the engine, but Rateau, a French manufacturer of centrifugal blowers, undertook the development of a turbo-blower; that is, of a centrifugal blower combined with a turbine operated by exhaust gases. In this country the Government induced the General Electric Co. to undertake development work along the same line, and the project was placed in charge of Dr. Sanford A. Moss. Dr. Moss was not unfamiliar with the subject, for he had done experimental work with gas turbines at Cornell University in 1902, and had made this the basis of a thesis which he presented to the Cornell Faculty the following year.

During the past decade there has been another revival of interest in gas turbines. Development work was initiated by two of the large Swiss machinery concerns, Brown-Boveri and Escher-Wyss. It was taken up in this country by the Allis-Chalmers Manufacturing Co., which to date has built a considerable number of units, and has designed a 5000-hp combustion-turbine locomotive with hydraulic transmission (see Fig. B). Development work on gas turbines is now being done here also by the General Electric Co. and the Westinghouse Electric and Manufacturing Co. It is noteworthy that all three of these companies have had extensive experience in the manufacture of steam turbines and kindred apparatus. While the General Electric Co. has been building exhaust-gas turbines for a good many years, the present development work aims at applications in large units, chiefly in the railway and marine fields.

Though it will probably be difficult to equal the thermal efficiency of the Diesel engine, which is substantially twice as high as that of the best gas turbine built up to now, considerable gains in efficiency are expected not only from the development of new materials of greater heat resistance (or, rather, greater high-temperature strength) and from improvements in turbines and compressors, but also from changes in the operating cycle whereby some of the energy now wasted is recovered. When the efficiency is only 18 per cent, as in present-day turbines, 82 per cent of the heat is lost through various channels, and it ought to be possible to recover a considerable proportion of the heat flowing through these channels. It is well known that the efficiency of steam power plants was gradually increased by such processes as feedwater heating by exhaust steam, multiple expansion, and super-heating. Some of the energy ordinarily

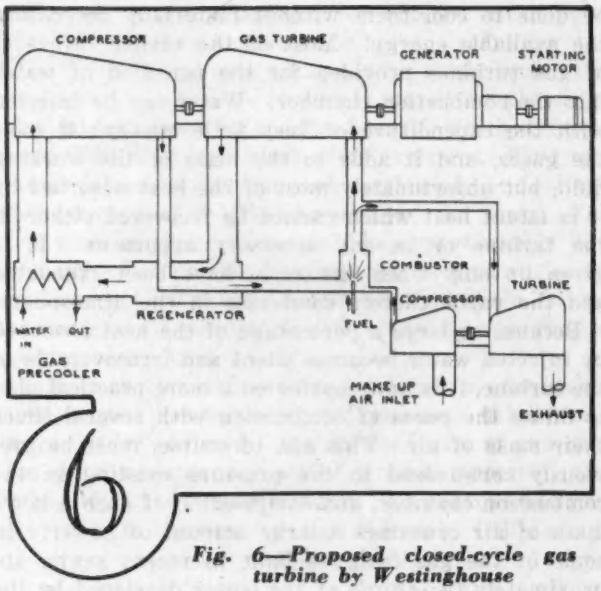


Fig. 6—Proposed closed-cycle gas turbine by Westinghouse

lost in gas turbines can be recovered in similar ways, and the overall efficiency of the plant increased correspondingly.

There are two basic types of gas turbine, known respectively as the constant-volume and the constant-pressure type. The descriptive terms "constant-volume" and "constant-pressure" refer to the conditions under which the fuel is being burned and heat is imparted to the working field. A constant-volume gas turbine is one in which a combustible mixture is burned in a closed chamber, as in the cylinder of a reciprocating engine. The turbines of turbo-chargers may be considered to be of the constant-volume type. In the engine the charge is supposed to be burned while the piston is at the top of the stroke and while the combustion chamber has a constant, minimum volume. Actually, of course, combustion extends over a certain time, during which the volume of the chamber varies. In supercharger applications the temperature of the gases of combustion is greatly reduced by expansion in the engine cylinders previous to their dis-

charge into the turbine, which alleviates the difficulty of keeping the turbine blades from overheating. Of course, the power developed in the charger turbine is only a small fraction of that developed in the engine cylinders.

Where all of the power is to be developed in the turbine, the combustible mixture is exploded in a closed chamber, and when the pressure of explosion approaches its maximum value, a valve is opened and admits the gases of combustion to the turbine nozzle or nozzles. When a gaseous mixture of readily-ignitable proportions is thus exploded, the resulting temperature is much too high to permit of admitting the gases directly to the turbine, and something must be done to cool them without materially decreasing the available energy. Most of the earlier inventors of gas turbines provided for the injection of water into the combustion chamber. Water can be injected with the expenditure of very little energy; it cools the gases, and it adds to the mass of the working fluid, but unfortunately most of the heat absorbed by it is latent heat which cannot be recovered either in the turbine or in any accessory apparatus. It is given up only when the gases have been exhausted and the vapor therein condenses in the atmosphere.

Because so large a percentage of the heat absorbed by injected water becomes latent and irrecoverable in the turbine, it is now considered a more practical plan to dilute the gases of combustion with several times their mass of air. This air, of course, must be previously compressed to the pressure existing in the combustion chamber, and compression of such a large mass of air consumes a large amount of power. In some of the gas turbines built in recent years, approximately two-thirds of the power developed by the turbine is absorbed by the compressor, and only one-third is available for useful work.

The principal champion of the constant-volume turbine has been the German engineer, Dr. Hans Holzwarth, who wrote a book on The Gas Turbine, of which an English translation was published in this country.

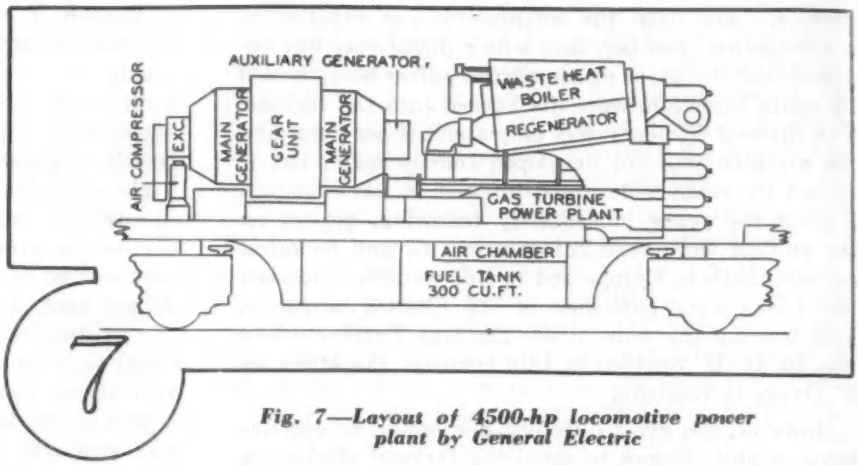


Fig. 7—Layout of 4500-hp locomotive power plant by General Electric

He designed a large turbine of which several were built, and some are said to be in service today. A series of combustion chambers is arranged in a circle at the base of the machine, into which combustible mixture is fed under pressure. After a chamber is fully charged, its intake valve is closed and the charge is ignited. Combustion of the fuel raises the pressure in the chamber, and a spring-loaded valve is opened by the pressure, whereby the gases of combustion are admitted to the turbine, which is arranged on a vertical axis immediately above the combustion chambers. An ingenious feature of the Holzwarth turbine is a hydraulic control which prevents the discharge valve from closing as soon as the pressure has dropped to the opening valve, holding it open until the gases of combustion have been completely swept from the chamber by a scavenging charge of fresh air. This scavenging charge also serves to cool the nozzle and the turbine blades. The turbine drives an electric generator mounted coaxially above it. Air for combustion is compressed by a compressor driven by a small steam turbine supplied from a waste-heat boiler built into the exhaust line.

Holzwarth gas turbines have been built by two large industrial concerns in Germany (Koerting Brothers and Thyssen) and by one firm in Switzerland (Brown-Boveri). One of the turbines operating on blast-furnace gas is said to have been in operation at the Hamborn steel works since 1933. There has been

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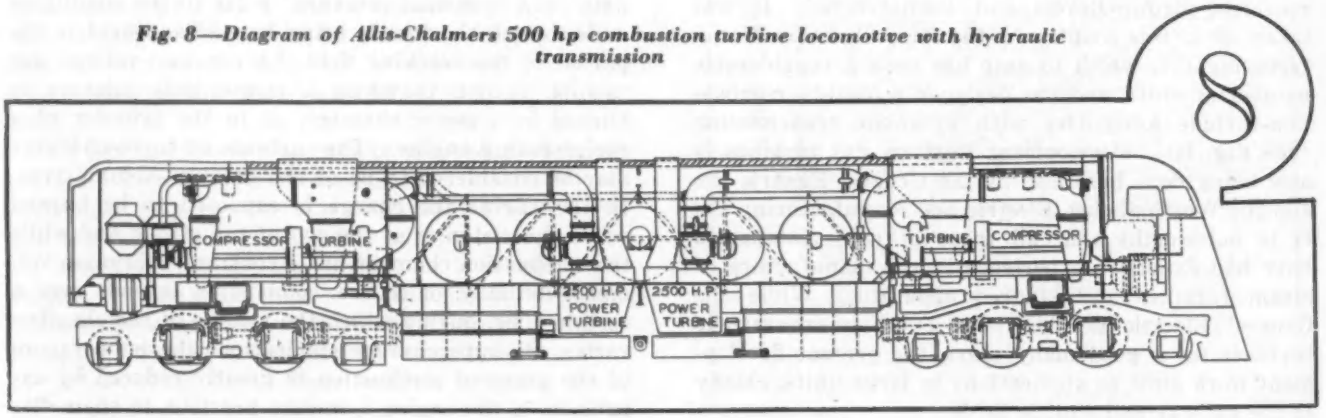
Fig. 8—Diagram of Allis-Chalmers 500 hp combustion turbine locomotive with hydraulic transmission



German Aerial Torpedo

Powered by Jet Propulsion Engine of Compressorless Type

By M. W. Bourdon

Special Correspondent of AUTOMOTIVE *and* AVIATION INDUSTRIES in Great Britain

BY PIECING together the more or less undamaged parts of a number of examples brought down on land, the British Air Ministry has been able to ascertain the details of the general design and construction of at least one version of the German "secret weapon" variously known as the "pilotless aircraft," the "flying bomb" and the "aerial torpedo." The Air Ministry uses the symbol "P. A./c" to signify "pilotless aircraft." The official designation given to them by the Germans is V-1 (Ve geltungswaffe or reprisal weapon).

It has been determined that several types are being used by the Germans, though only two of these seen, at the moment of writing, to be appearing in any numbers. First to be clearly identified is a type with a straight tapered wing of about 16 ft span and about 22 ft in length. A second type also being used in quantity has a parallel chord wing of about 18 ft span with square cut tips; this type is said to have a speed of about 350 mph, while the tapered wing variety is some 40-45 mph faster. Other variants reported include one with a wing of high aspect ratio and a span of about 23 ft. Yet another is said to be very much larger than the other three types, with a wing span of 30 ft.

Information on the construction of these missiles is largely confined to the version with straight tapered wing. It is an all-metal midwing monoplane powered by a reaction propulsion unit mounted above the rear end of the fuselage. The wing structure is composed of a single steel tubular spar extending from wing tip to wing tip; to this steel tube are attached ribs of pressed steel. Wing covering is of sheet steel. Ailerons are not fitted. The wing is set at about 8 deg dihedral. It is not possible to assess the power loading, but the wing loading is put in the region of 80-100 psi.

The fuselage, of circular section with a maximum diameter of 32½ in., is divided into five sections separated by pressed steel bulkheads and covered, except for the nose section, with steel sheet. The nose section is merely a light metal alloy fairing enclosing the "war-head," which contains about 2200 lb of high-blast-effect explosive. This section is joined to the fuel tank section of the fuselage just forward of the leading edge of the wing. The fuel tank capacity (gasoline) is approximately 130 Imp. gal. Behind the fuel tank is a section enclosing two large spherical wire-wound compressed air bottles, the contents of which are used to deliver the fuel to the propulsion unit.

The next fuselage section contains an automatic pilot, three pneumatic gyroscopes and height and range-setting controls. The forward part of this section accommodates the base of a strut supporting the front end of the propulsion unit. All controls and fuel pipes pass to the unit through the core of this strut.

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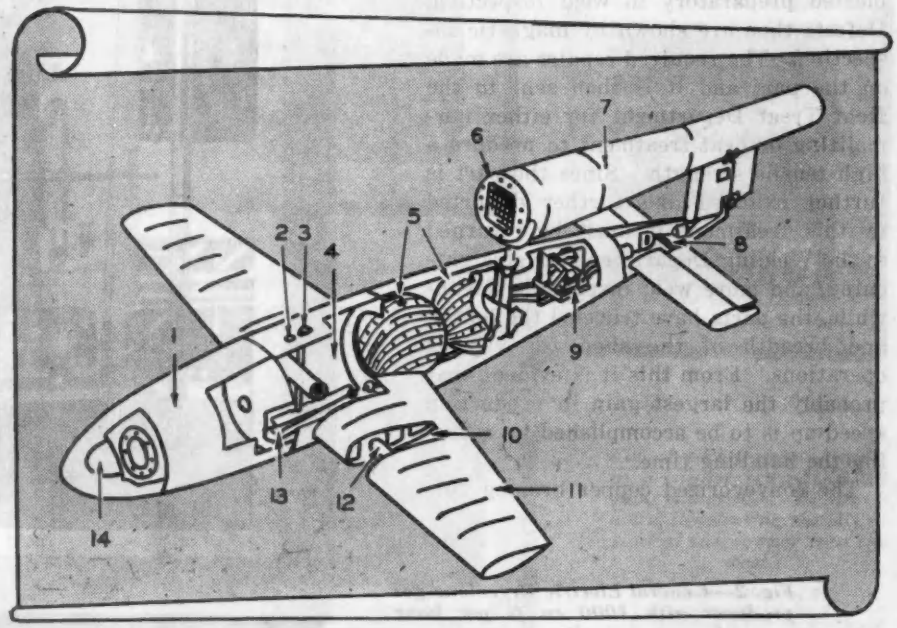


Diagram of the layout of the German aerial torpedo as indicated by examination of the remains of examples brought down in England. (Issued by the British Air Ministry).

1—Warhead: Approx. 1000 Kg.
2—Fuel filler cap.
3—Lifting lug.
4—Fuel tank capacity 130 gals petrol).
5—Wirebound spherical compressed air bottles.
6—Grill incorporating shutters & petrol injection jets.
7—Impulse duct engine.
8—Pneumatic servo mechanism operating rudder & elevators.
9—Automatic pilot: 3 air-driven gyros: Height & range setting controls.
10—Pressed steel wing ribs.
11—Sheet steel wing covering.
12—Steel tubular main spar passing through fuel tank.
13—Launching rail.
14—Light alloy nose fairing probably containing compass.

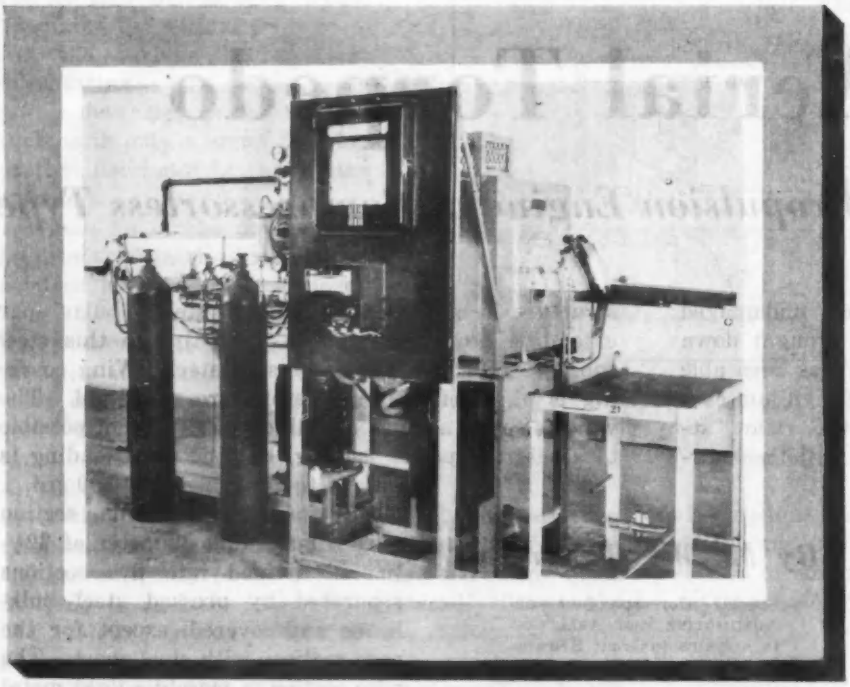


Fig. 1—(Left) setup at Consolidated Vultee plant of Hoskins brazing furnace with the Leeds and Northrop recording potentionmeter and bottled hydrogen atmosphere supply.

Fig. 3—(Right) General Electric copper brazing furnace equipped with cooling chamber and mesh belt conveyor.

Copper

By C. L. Hibert

Division Process Engineer, San Diego Div.
Consolidated Vultee Aircraft Corp.

THE problem of joining materials is centuries old, but it still demands the attention of our best engineering intellect. Years ago the tools for joining metals were essentially the forge and hammer. Today they are replaced by the torch and welding rod. The parts still have to be pre-heated, but the worker now makes the weld at a bench. He has a box of details on one side and a box for the finished parts on the other side. Welding is done at approximately 2800 F, which oxidizes the metal very badly so that the finished parts, after being permitted to cool, must be sand-blasted preparatory to weld inspection. Defects then are shown by magnetic inspection. The required repairs are made on the part and it is then sent to the Heat Treat Department for either normalizing or heat treatment to produce a high tensile strength. Since the part is further oxidized and further distorted by this treatment it must be returned to the Welding Department for straightening, and more weld inspection. Meanwhile, the parts have traveled the length and breadth of the shop for various operations. From this it is evident that probably the largest gain in production speed-up is to be accomplished by reducing the handling time.

The conveyorized copper brazing fur-

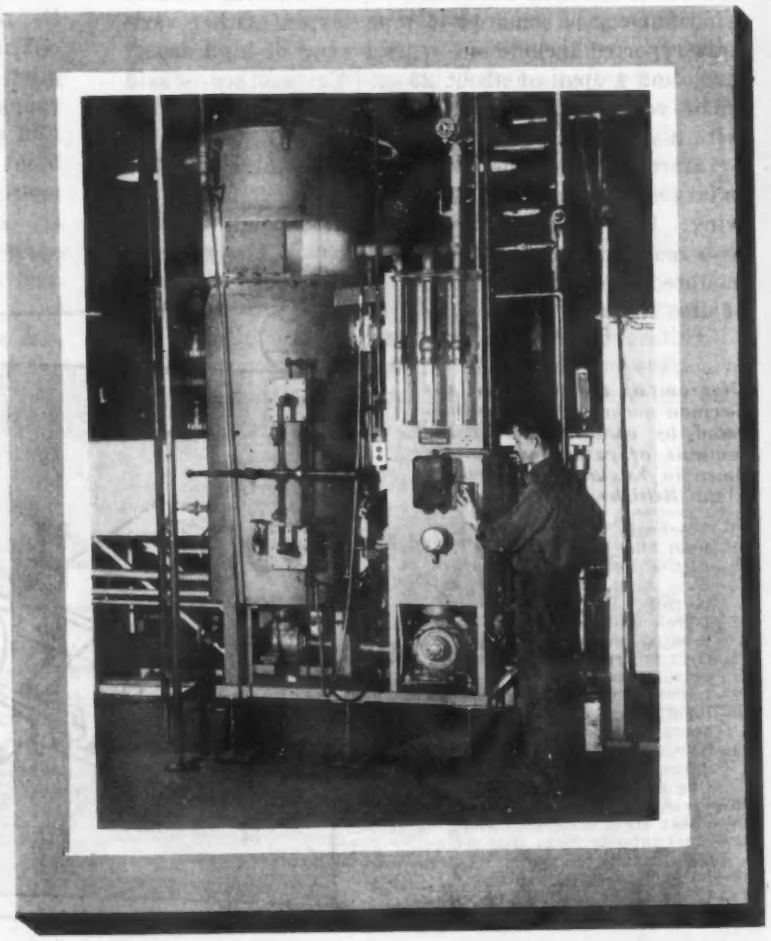
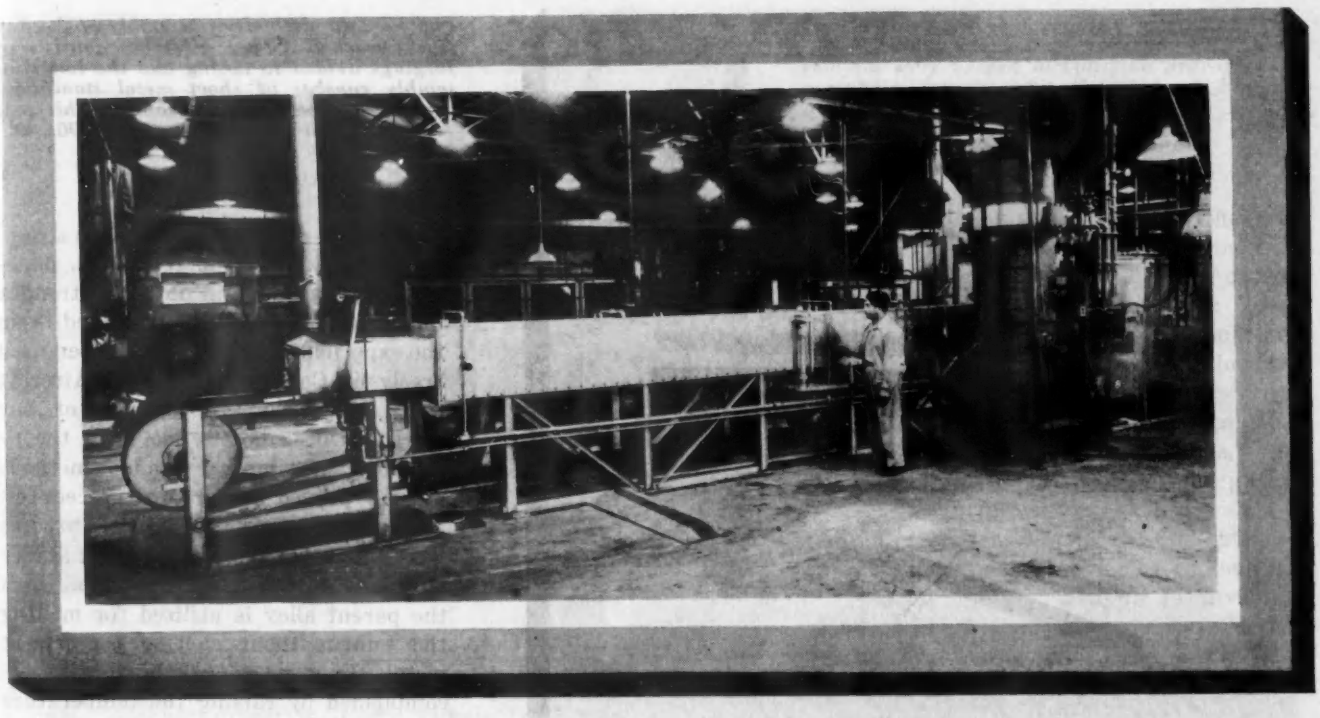


Fig. 2—General Electric Drycolene gas producer with 1000 cu ft per hour capacity.



Brazing

as a Production Tool

nace method is in sharp contrast to the extended transportation time element in welding processes. In copper brazing the parts are assembled by unskilled labor, placed on the conveyor belt, and after moving steadily through the process they come off the other end clean in appearance and ready for plating. It is not to be inferred that copper brazing will replace welding entirely; but it certainly will supplement welding in aircraft production. There is no reason why small assemblies designed with telescopic joints should not be furnace copper brazed.

Production problems may be analyzed as material handling time versus assembly time. It has been estimated that time spent in transporting parts from one section to another accounts for 70 per cent of the total time, whereas assembly time has amounted to about 30 per cent. Numerous studies have corroborated this estimate, that time involved in getting the work to the man or machine has amounted to much more than the actual fabrication time for the detail. The marvel is that the advan-

Fig. 4—Photomicrographs of a copper brazed X4130 joint magnified 50 diameters, illustrating the diffusion of the copper into the steel.

1—As brazed at 2050 deg. F.
2—Normalized at 1650 deg. F.
3—Quenched at 1650 deg. F.—Drawn at 800 deg. F.

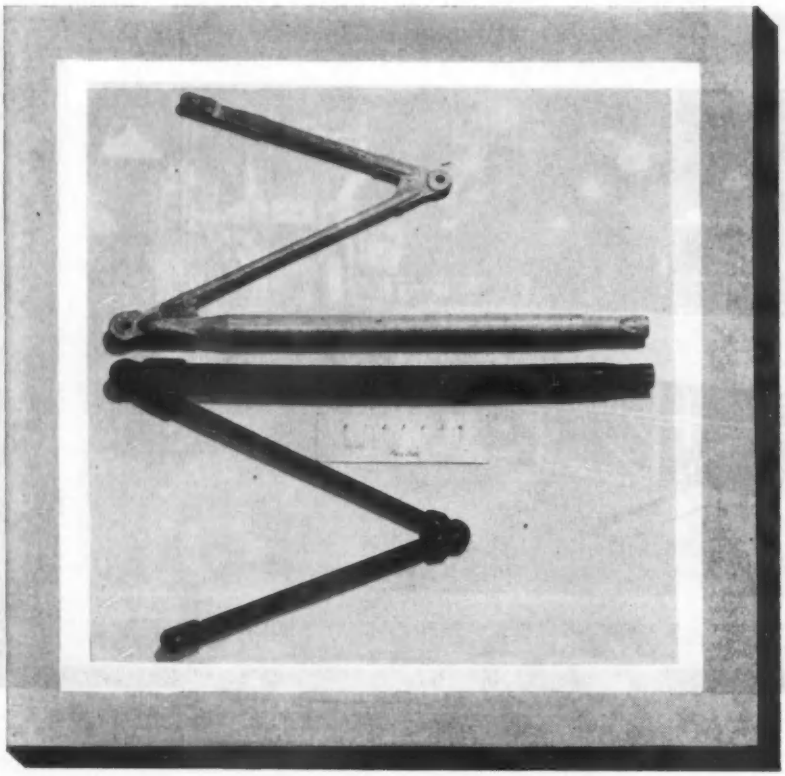


Fig. 5—Two methods of assembly of the flap track bracket. Upper assembly consists of forgings welded to tubing and the lower assembly consists of sheet metal stampings, copper furnace brazed to tubing. This part requires heat-treatment for 150,000 psi.

tages of reducing handling time still goes unheeded in many aircraft plants. It has been stated that production begins with transportation and as a corollary it might be added that production time actually depends on transportation.

The copper brazing process has been investigated thoroughly by the General Electric Co. at Schenectady, N. Y., and by the Material Division of the Army Air Forces at Wright Field, Dayton, Ohio. The process has been in commercial use for approximately 10 years by manufacturers of office equipment such as typewriters and adding machines, and during the last few years prior to the war, it came into use in the automobile industry. The production speed made possible by this process warrants its adaptation to the aircraft industry for both war and peacetime needs.

The process has had sufficient research and tests to establish definitely its value as a joining method. Data on technique, material, applications and physical strength of copper brazed joints, collected from the experience of others, have been used freely by Consolidated Vultee Aircraft Corp. The primary purpose of our work has been not to prove the theory of copper brazing, but to adapt methods already proved to our own procedures.

The term brazing describes a process that differs from welding in that a filler material of a lower melting point than the parent alloy is utilized for making the joint without melting the parent metal. Furnace copper brazing is accomplished by raising the temperature of an entire assembly until the copper melts and flows into the joint.

In 1935 the Army Air Corps Materiel Division, Wright Field, did some experimental work on the copper brazing of 4130 steel and issued two reports on the subject. But no interest was shown by aircraft manufacturers in this process until it became apparent that there would soon be a definite shortage of man power. especially in skilled trades. In order to conserve man power, it was necessary to seek means whereby machines could do certain types of work joining materials. For every man removed from the manufacture of details one man could be placed on the assembly line where the work still cannot be done by machinery.

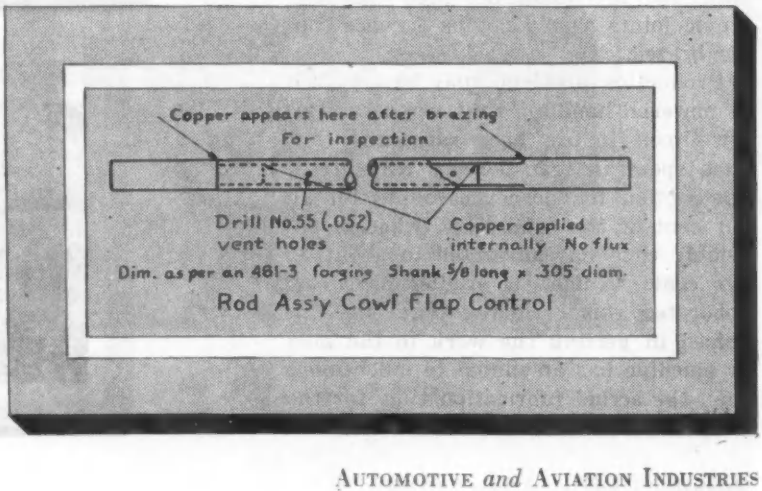
The San Diego Division of Consolidated Vultee Aircraft Corp. experimented with atmospheres for copper brazing in the latter part of 1941, using a small muffle manufactured of stainless steel. This muffle had a false bottom, the lower half of which was charged with charcoal briquettes to generate the atmosphere. It was heated in a high speed furnace maintained at

Fig. 6—Assembly of a typical aircraft control rod. The AN forgings which were mocked up in this case are of two types: studs and clevis. These are ordinarily torch welded or flash welded.

TENSION TEST RESULTS OF COPPER BRAZED CONTROL ROD ASSEMBLIES

Specimen	Condition	Ultimate Load	Point of Failure
1	As brazed	3860 lb.	Vent hole in tubing
2	As brazed	3620 lb.	Vent hole in tubing
3	Normalized	3925 lb.	Vent hole in tubing
4	Normalized	4300 lb.	Vent hole in tubing
5	Normalized	4500 lb.	Vent hole in tubing
6	Normalized	4170 lb.	Vent hole in tubing

In no case did the copper braze fail. All failures were within the 90,000 psi to 120,000 psi range for the nominal area of the C. M. steel tube. This is considered satisfactory for normalized C. M. steel. Calculated shear stress on copper braze joint at maximum load of 4500 pounds equals 7500 psi.


Copper appears here after brazing
For inspection
Drill No.55 (.052) vent holes
Copper applied internally No flux
Dim. as per an 481-3 forging Shank 5/8 long x .305 diam.
Rod Ass'y Cowl Flap Control

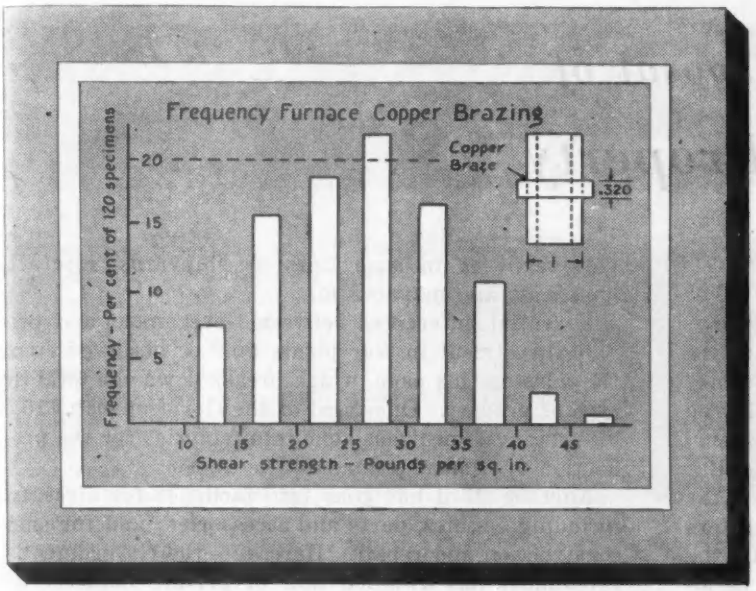


Fig. 7—Data for this frequency bar chart were taken over a period of six months. These samples were brazed in both the hydrogen atmosphere furnace and the General Electric furnace.

a temperature of 2100 F. The results were amazingly simple. Without exception, every sample tried was satisfactorily brazed under these conditions. This preliminary work was done in order to gain some information prior to the arrival of the proper furnace equipment.

With the melting point of the copper approximately 1950 F, a temperature of 2050 to 2100 F is used for brazing. This temperature, because it exceeds the heat-treating temperature of low alloy steels, permits a heat-treating operation after brazing. A little improvement has been noted in shear strength joints after heat-treatment with no deleterious effect on the brazed joint. It has been our practice to heat-treat chrome moly steel at a temperature of 1550 to 1650 F after brazing.

To insure best results in copper brazing, it is necessary to provide an atmosphere that takes the place of fluxing in ordinary brazing. A suitable controlled atmosphere depends for its functioning on the absence of oxygen, water vapor and carbon dioxide. Ordinarily, for copper brazing these atmospheres are charcoal generator gas, pure hydrogen, partially burned fuel gas, or combinations of the three. The small Hoskins unit shown by Fig. 1 utilizes bottled hydrogen as a furnace atmosphere. In order to remove the water vapor sometimes present in bottled gas, a silica gel dehydrating unit was installed.

The General Electric furnace utilizes an atmosphere of partially burned fuel gas cooled to room temperature to remove the water vapor. Carbon dioxide and oxygen are then removed by passing the gases through a retort containing charcoal which causes the following chemical reactions:

When a hydrocarbon gas is completely burned, the products of combustion are carbon dioxide (CO_2), water vapor (H_2O), and nitrogen (N_2). Since combustion is usually not complete, free oxygen (O_2) from the unburned gas is generally present.

Controlled atmosphere gas is obtained by passing such products of combustion (flue gas) through a highly reactive carbon at high temperature, the following reactions taking place:

$$CO_2 + C = 2CO$$

$$H_2O + C = CO + H_2$$

$$O_2 \text{ (if present)} + 2C = 2CO$$

At approximately 2000 F the reactions are complete and the carbon dioxide and water are reduced to small

(*Turn to page* 67, *please*)

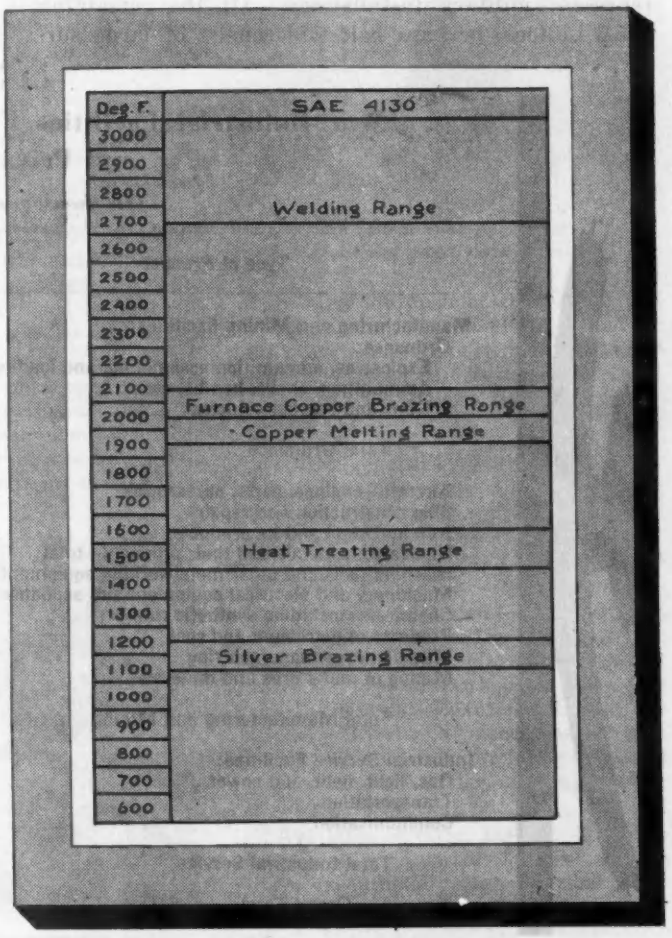


Fig. 8—This chart illustrates the various temperature ranges on SAE 4130 steel commonly used in aircraft manufacture. The furnace copper brazing temperature is sufficiently above the heat-treating range to permit heat-treatment without affecting the shear strength of the joint.

CED Views on Disposal of Government Surplus Property

In a statement on National policy discussing "Postwar Employment and the Liquidation of War Production," the Committee for Economic Development expresses an optimistic attitude toward the postwar problems of disposing of Government-owned surplus goods and war plants. If the war should end tomorrow, the CED estimates, Government-owned surplus goods would probably not exceed $60 billions. But from the point of view of business the problem is far smaller than this sum would indicate. Three quarters of the surplus stocks will be combat ordnance. Of the $15-billion that is merchantable, fully half will be located abroad. The remaining $6 or $7 billions, only part of which is consumer goods, is equivalent in dollar magnitude to only two months' normal retail sales. While there may be heavy over-supply in special lines, the great bulk of the stock can be disposed of without seriously interfering with the readjustment of business to peacetime production, provided the disposal is carefully planned in advance and properly timed.

Disposal of Plants—CED estimates that the Government has invested $33 billions in plant and facilities during the emergency. But $17.5 billions of it represent military installations. Of the remaining $15.5 billions, perhaps half will consist of large surplus facilities in such lines as shipyards, aircraft, aluminum and magnesium.

Essential differences between Government and private investment in war plants may be observed from the table on this page, which breaks down the total by type of product. One-third of the Government's $15.5 billions investment has gone into facilities for the production of combat ordnance.

Another third has gone into facilities for aircraft, including engines, parts and accessories; and for ship construction and repair. Here, too, the Government's investment has dwarfed that of private industry so that the Government now owns nearly nine-tenths of the total capacity in these two fields. The aircraft investment, exceeding $3 billions, represents a 4000 per cent expansion in three years.

The last third of the Government's $15.5 billions investment has gone into many different types of plants, including those for synthetic rubber and chemicals; products of petroleum and coal; metal products, machine tools, machinery and electrical equipment and appliances; and a wide variety of miscellaneous manufacturing facilities. In this area private investment has matched or exceeded the Government outlay, the

(*Turn to page* 50, *please*)

War Industrial Facilities Financed with Government and Private Funds

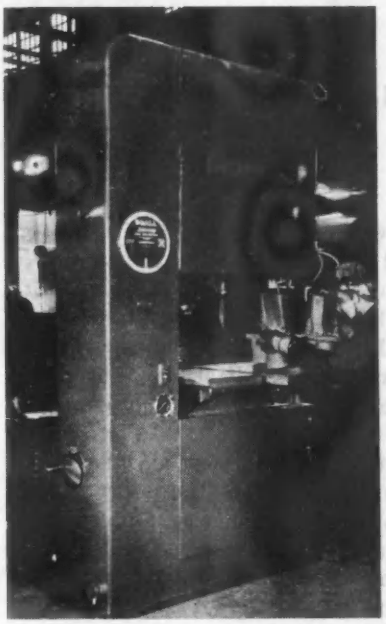
(In thousands of dollars)

Type of Product	Estimated Cost		
Manufacturing and Mining Facilities:	**Government**	**Private**	**Total**
Ordnance:			
Explosives, ammunition assembling, and loading	$2,848,346	$20,651	$2,868,997
Ammunition, shells, bombs, etc.	1,093,138	141,015	1,234,153
Guns and combat vehicles	1,225,370	214,796	1,440,166
Total Ordnance	$5,166,854	$376,462	$5,543,316
Aircraft—engines, parts, accessories	3,113,768	282,089	3,395,857
Ship construction and repair	2,128,465	172,932	2,301,397
Iron and steel and its products	1,068,866	881,097	1,949,963
Non-ferrous metals and their products—total	1,167,568	362,797	1,530,365
Machine tools and other metalworking equipment	139,144	159,097	298,241
Machinery and electrical equipment and appliances	485,846	290,200	776,046
Chemicals (including synthetic rubber)	1,188,579	412,613	1,601,192
Products of petroleum and coal	211,465	595,641	807,106
Miscellaneous manufacturing	239,112	353,919	593,031
Mining of metal ores and minerals	147,424	176,177	323,601
Total Manufacturing and Mining	$15,057,091	$4,063,024	$19,120,115
Industrial Service Facilities:			
Gas, light, heat, and power	472,767	794,655	1,267,422
Transportation	191,309	1,188,885	1,380,194
Communication	3,975	131,320	135,295
Total Industrial Service	$668,051	$2,114,860	$2,782,911
Grand Total	$15,725,142	$6,177,884	$21,903,026

New Production Equipment

CONTINENTAL Machines, Inc., Minneapolis, Minn., is introducing a high speed sawing machine known as the DoALL Zephyr. It features a 36-in. throat depth and a 20-in. work thickness capacity, with a speed range from 1500 to 10,000 fpm. This speed range is infinitely controlled by a "Speedmaster" variable speed pulley and indicated by a tachometer. Automotive type hydraulic brakes are provided on the upper and lower wheels.

Standard equipment includes a 10-hp

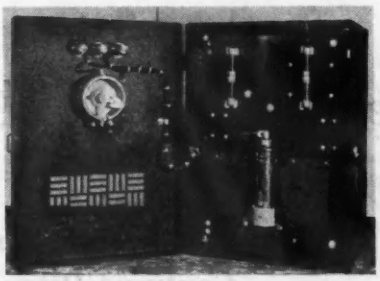


DoALL Zephyr sawing machine

variable speed drive, a 30-in. by 30-in. work table and a secondary table extension 17 in. by 20 in. The table has a four-way tilt, 45 deg to the right, 10 deg to the left, front, and rear. An adjustable lamp is supplied for illumination at the point of work. Pipe flange arrangements are provided for exhaust removal of chips.

SUITABLE for welding small objects of high conductivity such as aluminum or copper, a new precise welding timer with heat control for timing intervals of one-half cycle or less is now in production at Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

Precise, because the welding current is made to start at the same point on the voltage wave for every operation, the new SP-18, ½ cycle timer is designed for welding of such items as



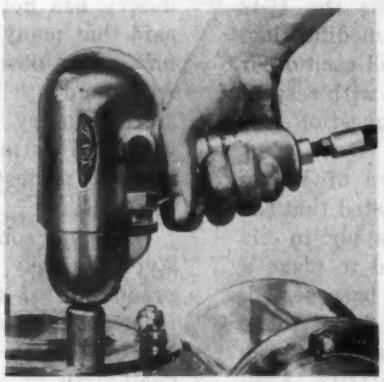
Westinghouse spot welding timer and heat control

radio tube parts and sockets, pig-tail resistors to terminal lugs, watch and instrument parts, contact tips on electrical relays and other small parts.

The timer is furnished as a separate control for use with existing small bench welders and also in combination with a small welding transformer. Only one control tube is used, this thyratron serving the dual purpose of rectifying alternating current to charge a firing capacitor and also firing the small ignitron power tube. Heat control is accomplished by a phase shift method, the adjustment dial for which is mounted on the cabinet door.

A NEW ⅜-in. impact wrench that operates with controlled torque is offered by The Aro Equipment Corporation, Bryan, Ohio. This pneumatically powered tool is capable of both forward and reverse rotation and has a calibrated adjusting screw on the side of the motor that enables the operator to set any bolt or nut to any desired tension.

The control is obtained primarily through the construction of the roller clutch impacting mechanism which consists of four major parts—anvil, hammer, and two cylindrical steel rollers.

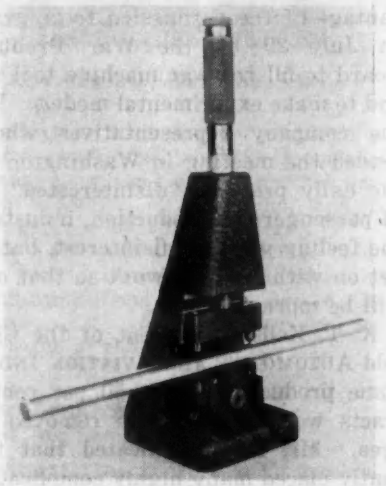


Aro impact wrench

When in operation, centrifugal force throws the two steel rollers out against the hammer where they are caught in shear between the hammer and anvil members. This transfers the full torque through to the work in the form of a sudden impact. When the selected torque is obtained, the rollers rebound from the anvil face and do not allow the hammer to engage for impact.

The Model 131 has a capacity up to ⅜-in. bolt size, is only 6¾ in. overall in length, and weighs 4¼ lb. It comes complete with one socket and 8-ft. of 5/16-in. hose with fittings.

THE Baldwin Locomotive Works, Eddystone, Pa., is marketing a gage point punch which is double-acting and on which impact force is adjustable for different materials. The new device marks four uniform centers on speci-



Baldwin gage point punch

men with one push of the handle and automatically centers either round or flat specimens. Impact force is applied manually by an adjustable detent which eliminates the use of a hammer.

A NEW general-purpose electrode for mild steel, designated as "Fleetweld 35," and made specifically for operation on alternating current, has just been announced by The Lincoln Electric Company, Cleveland, Ohio.

This new shielded arc electrode, which will also operate on direct current with either polarity, depending upon the type of work being done, has all the desirable characteristics of the Lincoln "Fleetweld" electrodes for high speed welding of single or multiple passes for work in flat, vertical or overhead positions.

Available in ⅛-in. 5/32-in. and 3/16-in. sizes, "Fleetweld 35" is said to have exceptionally high physical properties, the as-welded weld metal speci-

(*Turn to page 87, please*)

War Work Prevents *Resumption of Passenger* Car Production

Company Executives and WPB Officials Continue Discussions on Various Phases of Reconversion, Including Initial Quotas

By Donald Browne

LEADING automobile executives told war agency officials on July 14 that they are interested in taking advantage of the permission to be granted on July 29 by the War Production Board to fill postwar machine tool needs and to make experimental models. While the company representatives who attended the meeting in Washington were described by the daily press as "disinterested" in the resumption of passenger car production, industry sources say that the feeling was not disinterest, but rather a desire to get on with the war work so that one-day discussions will be more practical.

K. T. Keller, president of the Chrysler Motor Co., told AUTOMOTIVE AND AVIATION INDUSTRIES that to resume production about 50 per cent of the war contracts would have to be removed from the Detroit area. Mr. Keller indicated that the Army has recently placed many highly complicated production jobs in the area and with the shortage of engineers, no production is feasible until Germany is defeated.

The reported lack of interest arose from the fact that automotive leaders discarded the too cumbersome "blue order" plan which proposed that parts manufacturers, who have been certified by the WPB as being in position manpower-wise to make civilian parts, get permission from automobile companies to make parts in advance on the basis of tentative quotas.

While it was generally agreed that the postwar passenger car would be nearly the same as the 1942 model except for the exterior style modification, manufacturers could not be expected to tell each other exactly what their companies intend to do with respect to new models, WPB officials said. The question of a victory model was not discussed.

Ward Canaday, chairman of the board of Willys Overland Motors, Inc., is said to have insisted that the historical production quota should not apply to his company, that Willys should be permitted to make a great many more cars than it did in the base period.

Quotas discussed at the meeting were found to be generally satisfactory to all by Canaday. It was emphasized that all allotments were tentative, however. A principal point of difference between industry and Government was whether the initial reconversion program should be carried out under Governmental controls of materials and manpower. Industry contends that control of the number of units to be built will automatically regulate these factors. Government officials were noncommittal on this point, stating only that regulation would be provided if needed.

Although not discussed at the meeting, the possibility of all companies being able to start simultaneously on automobile production was doubted later by Charles E. Wilson, vice chairman of WPB, who presided. It is understood that all will be given approval to resume at the same time, but some companies will be able to move faster than others in getting started. At most, Government men said, the difference in actual production starting time would be only one or two months.

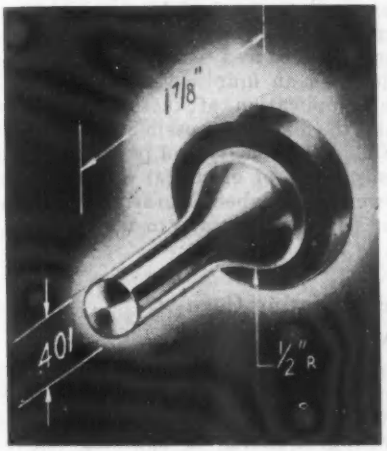
Automobile men said that the steel industry does not want to immediately furnish steels of the specifications sold before the war and are offering steels developed during the war which the automotive industry has not had an opportunity to test. It was said that many thousands of hours of research would have to be devoted to finding out how the new steels will stand up. One company executive said that the steel industry has plenty of orders now, but there would be a time when it would be glad to furnish without protest what is wanted by the automobile companies.

Of equal concern are machine tools, it was said. Approximately 7500 machine tools, or one month's production of the tools industry, will be needed in reconversion. Advisory committee members said that the automobile industry could secure an additional one-fourth of its needs by purchasing Government-owned tools.

New Products for Aircraft

Rivet Set has Guard To Prevent Slipping

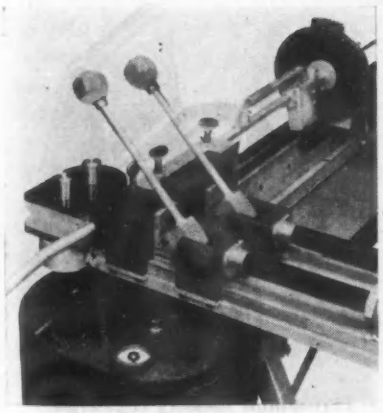
Emerson Engineering Company, Los Angeles, Cal., has brought out a new rivet set, named the Double EE Saf-T-Set, which is said to eliminate danger of the flush set slipping or skidding off the rivet being driven. It includes a protective rubber ring, slightly higher than the driving surface, which acts as a guard and eliminates the possibility of marring the riveted surface. The rivet set face is slightly crowned and highly polished. Various shank and face diameters are available.



Emerson rivet set

Manually Operated Tube Bender

A manually operated tube bender, which is said to produce 900 to 1000 bends per hour, is now being manufactured by Leonard Precision Products Co., Garden Grove, Cal.



Leonard-Douglas Bendmaster

The Leonard-Douglas Bendmaster, as it is named, will handle non-ferrous tubing from ⅜ in. to 1¼ in. O.D., producing from one to 10 different bends in a single 9 ft length of tubing. These bends can be produced to any specified degree of angle up to 180 deg and at any radial angle. Special models for tubing up to 20 ft are available for special jobs.

Standard bend, follow and clamp blocks are adaptable to the Leonard-Douglas Bendmaster, and in special cases the machine can be furnished to fit any bend blocks.

Teardrop Enclosures Formed by New Method

"Teardrop" enclosures are formed by a new method from single sheets of "Lucite" methyl methacrylate resin at Swedlow Aeroplastics Corporation, Glendale, Cal., for use on model P-51 Mustang fighter planes.

The new process shapes the transparent cockpit hoods in much the same manner as a soap bubble is blown. Held at the edges by a ring which controls the ultimate shape of the piece, the heated plastic is forced by air pressure to take the shape of a teardrop. This method, called "free-blowing," eliminates the direct pressure of molds upon the plastic, producing canopies in which optical distortion is reduced. The bubble canopies also improve rear vision for the pilot.

Enclosure made from a single sheet of Lucite

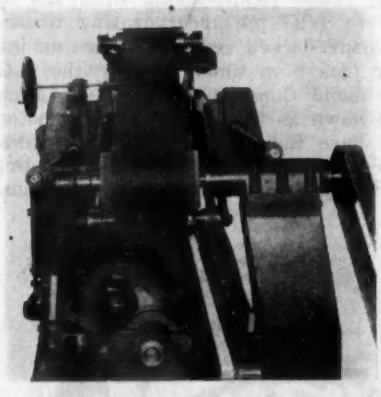
Grinding Machine for Propeller Blades

A continuous strip grinding machine for grinding propeller blades has been designed by Hamilton Standard Propellers, a division of United Aircraft Corporation, and is manufactured by the Murray-Way Corporation, Detroit, Mich.

The machine is one of the few sanding grinders in existence capable of grinding a variable surface, a problem presented by propeller blades which vary in width, thickness and angle throughout their length.

The continuous strip grinder grinds longitudinally with the blade, running over and being guided by a forming drum synchronized with a table moving lengthwise through the rectangular frame of the machine. The drum suspended above the blade governs the pattern to which it is ground, and is changed for each blade design.

Both the face and back of the blade are ground to accurate dimensions by duplication from the contours of the drums, a different drum being used for each side of the blade.

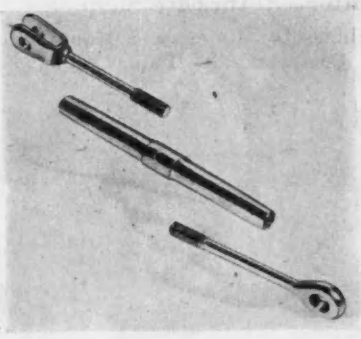


Hamilton propeller blade shaper

Turnbuckles Made by New Methods

Aircraft turnbuckles and parts developed by Reliable Electric Company, Chicago, Ill., are said to be produced by new methods of manufacture, resulting in savings of materials and time. Raw material in less critical forms is used; for example, strip instead of cold drawn bar stock.

The turnbuckles are made in accordance with AAF Specification AN-T-19, and are used in aircraft assemblies according to the standards set forth in "The Handbook of Instructions for Airplane Designers."



Aircraft turnbuckle made by Reliable Electric Company

New Products

Motor with Pressure-Locked Resilient Mounting

A shaded pole totally enclosed motor for power requirements of 1/125 hp up to 1/25 hp, incorporating a new pressure-locked, resilient, rubber mounting, has been announced by the A.G. Redmond Company, of Owosso, Mich.

Known as the type "T" Micromotor, all base mounted models will utilize the new rubber mounting providing quiet operation. The mounting assembly consists of two rubber pads, two spring steel lock rings, and a base welded into a single unit.

Redmond totally enclosed electric motor

The type "T" Micromotor uses patened "Flush-Weld" rotor design. All rotor slots are copper filled flush with circumference with preformed copper inductors, fuse welded permanently into position for maximum electrical conductivity in the circuit. Modifications for different performance characteristics can be met by change of inductor resistance.

A small overall size motor is made possible by the Redmond Air-Stream cooling system using enclosed fins and fan.

Reinforced Abrasive Strip

Minnesota Mining and Manufacturing Company, St. Paul, Minn., has brought out an improved spiral wound abrasive strip, named the Eleck-Tro-Cut Three-M-Ite cloth reinforced spiral wound strip. The reinforced center permits bending the strip for insertion in hard-to-reach oil holes or other openings. The new abrasive strip is available in a wide range of grits, in diameters of 1/16 in. to ¼ in., and in lengths up to 12 in.

Elek-Tro-Cut Three-M-Ite cloth reinforced spiral wound strip

Shipping Container for Storage Batteries

Employing a "vacuum-pack" principle, an unusual type of storage battery is now being produced by the Willard Storage Battery Company, Cleveland, Ohio, for use by our armed forces.

Four batteries—three 36-volt types and one 6-volt—are packed in a lead-plated metal container from which the air is exhausted. The batteries retain their charge indefinitely and are ready for immediate use regardless of the time elapsed since their manufacture.

When the batteries are about to be placed in service, the can is punctured by a special filling device and the vacuum inside the can draws the electrolyte quickly into the 18 miniature vent holes in each battery. Thus, in a matter of seconds, each battery is filled with electrolyte and is ready to go to work.

Willard battery container

Welding Rod Reclaims Zinc Base Die Castings

Zinc base die castings, which are normally difficult to repair, can be reclaimed with the improved gas welding rod "195" that is now being marketed by the Eutectic Welding Alloys Company, New York, N. Y. The rod has a lower melting point and a still lower bonding temperature than the original alloy, making it easier to apply without danger of damaging the parent metal. The maker states that the improved rod is easier to build up with, has greater tensile strength, and matches the hardness of the die castings.

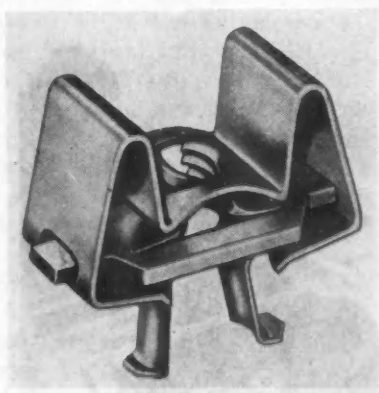
Dow Corning Corporation Now Making Silicones

The first commercial production of silicones has just been announced by the Dow Corning Corporation, Midland, Mich. These silicones are the result of many years of research to utilize silicon and oxygen, the elements of which sand is composed, in the production of new temperature-resistant materials. Among the most important of these silicone materials are high-temperature insulating resins, but silicones can be produced either as solids or liquids in an infinite variety of forms. The application of these products is said to make it possible to improve reliability, capacity and performance of many types of electrical equipment by permitting higher operating temperatures without damage to insulation.

New Floating Cage-Type Speed Nut

A new floating cage-type Speed Nut recently developed by Tinnerman Products, Inc., Cleveland, Ohio, requires no riveting, welding or spinning operations, nor any special tools, to install it in position for blind attachments. Compressing the cage allows the insertion of the legs in the clearance hole. When the cage is released, the legs spring apart, holding the nut tight against the force of inserting and tightening the screw.

Although originally designed for front mounting of aircraft instruments, (approved by Army Air Forces), this new cage nut may be used for any type of blind attachment. It is available in two styles: A6939, made of brass and phosphor bronze, for use with standard 6-32 machine screws, and A5939, made entirely of spring steel, for use with



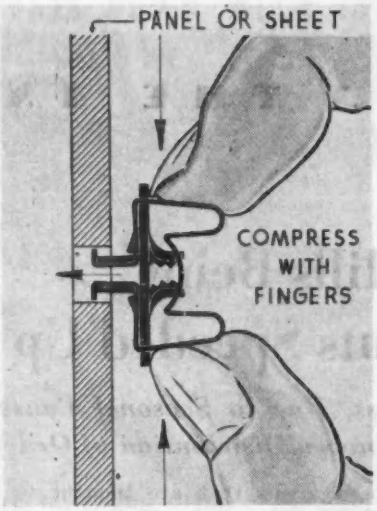
Tinnerman floating cage-type Speed Nut

standard 6Z sheet metal screws. Both styles are available to fit panel thicknesses from .062 in. up, and require only one clearance hole of .171 in. diameter to attach.

Polyethylene Plastics

Carbide and Carbon Chemicals Corporation, New York, N. Y., has just released information on the development of polyethylene plastics, component of coaxial cable used in radar equipment.

These polyethylene plastics are inherently flexible, translucent materials that possess many unusual properties. They have excellent insulating properties, and are tough and resistant to shock. The amount of water they will absorb is inappreciable, while films of the material will not permit the passage of appreciable amounts of water vapor. In addition, polyethylene softens at the unusually high temperature for thermoplastic materials of 230 deg F, and remains virtually unaffected by temperatures 90 deg below zero, F.



Sectional view of Tinnerman cage-type Speed Nut

Latex Type Thiokol Sealing Compound

Presstite Engineering Company, St. Louis, Mo., is introducing a new sealing compound known as Galco. This material is a Thiokol synthetic rubber compound of the latex type, designed for spray, brush, or slush application.

Galco was developed especially for the sealing of airplane integral fuel tanks, but has characteristics that make it suitable for many other uses. It has very low diffusion rate, low solubility in aromatic fuel or water, and very high adhesion to aluminum, steel, wood, and other surfaces. Galco will maintain a tight seal at extremely high and low temperatures.

(*Turn to page 64, please*)

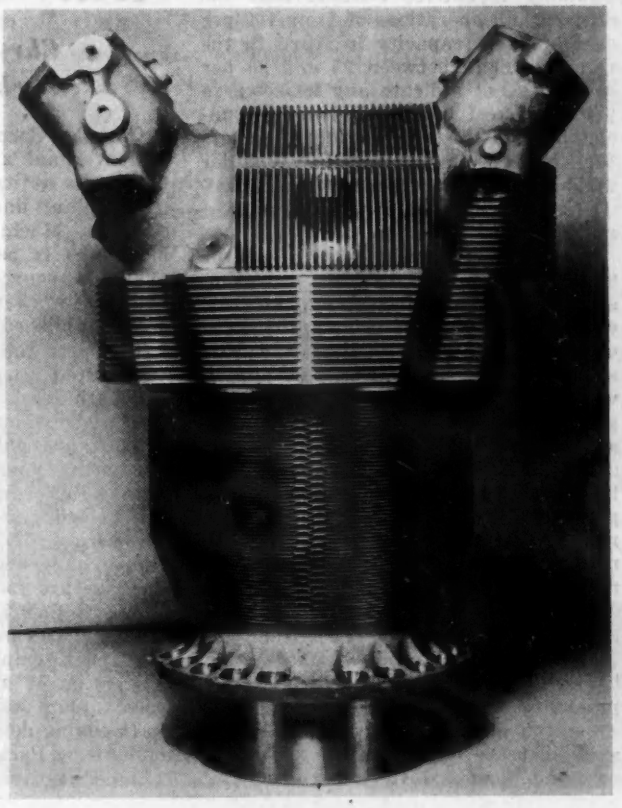
Wright Engine Cylinder Barrels Equipped with Aluminum Fins

DEVELOPED by the Wright Aeronautical Corp., with the cooperation of the Scandia Mfg. Co., the new aluminum fin design now being used on the steel cylinder barrels of Cyclone air-cooled engines is said to provide almost twice the cooling area of the former all-steel fins. Sixty aluminum fins are mounted on each barrel in the same space formerly required for 40 steel fins machined from the barrel wall. The increased cooling area, coupled with the fact that aluminum can dissipate heat more rapidly than steel, results in cooler operation, and in turn permits more power to be taken from the engine.

Formerly, cylinder barrel fins were machined by cutting 40 narrow grooves, each $\frac{5}{8}$ in. deep, into a solid steel barrel with a wall $\frac{3}{4}$ in. thick. This machining reduced the actual thickness of the cylinder wall to $\frac{1}{8}$ in. and also left standing on the barrel 40 fins, each fin with a thickness of only 0.025 in.

The new fin, known as the "W" fin, is produced by folding a strip of sheet aluminum into the form of an extremely exaggerated letter "W," with the two outside legs 1.0 in. high and the center portion only $\frac{1}{8}$ in. in height. These strips are cut to size, shaped into half-circles and then snapped into shallow dovetail grooves cut into the barrel. A special tool then rolls over the short center section of the "W," flattening this section and wedging the outside legs of the "W" into the dovetail grooves. This wedging not only holds the fin firmly in place, but also provides a broad contact area through which heat can pass from the steel wall of the barrel into the aluminum fin. The aluminum fins can be made to almost any desired height, while the steel fins had virtually reached the maximum depth to which they could be cut in quantity production.

While this new barrel does not materially affect the over-all weight of the engine, the saving being only one pound per cylinder, there is a very important saving in the quantity of raw material required, the rough forging for the new barrel being substantially lighter than that for the older model. In one year's production of Cyclones, this saving will amount to 24,000,000 pounds of alloy steel.



Backlogs of Steel Mills Being Cut Down, Shipments Speeded Up

Rate of Production Is Less, Due to Seasonal Causes, Diminution of Labor and Uneven Distribution of Orders

By W. C. Hirsch

Steel producers as well as steel consumers are keenly aware of the anomaly of the situation confronting them because the one factor that would bring clarity into the market picture, the complete defeat of the enemy on the battlefields of Europe, while certain in the end, still remains to be accomplished. The appeal by WPB to carbon steel users to review their inventories and nearby requirements with a view to freeing as much steel as possible for the most essential war effort has resulted in whittling down backlogs of mills and in more prompt shipments of what tonnages war plants need most urgently. It is pointed out that officials of war requirement procurement agencies may have become unduly uneasy over the shrinkage of steel production in recent weeks, partly the result of diminution of steel mill labor and partly of seasonal causes. A majority of steel company executives contend that the drop in mill operations of from 100 per cent of rated capacity in April to the recent level of between 95 and 96 per cent does not indicate any let-down in primary steel output, but rather unevenness in the distribution of orders for finished steel products. Whether amid the fluidity of present combat requirements this could be avoided is a matter of individual opinion.

In the sheet market cutting back of the shell container program, releasing some 100,000 tons of steel quarterly for other uses, is pointed to as an instance of the difficulty of foretelling in a war, such as this one, what will be needed when and where. Tightness in the supply of flat rolled steel has so far acted as the principal brake on plans for increased light motor truck output authorization. As somewhat of a disappointment to the steel industry come recent statistics of electric steel furnace output and demand. Current business in electric steel is reported to have dipped to less than 80 per cent of capacity and plans for expansion are being held in abeyance for the time being. Recent adjustment in NE steel prices by OPA, providing a $2 per gross ton decrease on two grades and a $3 increase on two other grades, is bringing some shifts in consumers' specifications that are thought to be helpful. Announcement that England has recently volunteered to send 10,000 tons of steel plate a month to the United States is taken to indicate marked improvement in the position of England's steel industry, although the tonnage involved is unimportant when compared with the 1,000,000 ton monthly output of U. S. plate mills.

In connection with recent WPB orders, lifting many of the restrictions on the purchase and uses of the light metals: aluminum and magnesium, some potential consumers of aluminum in alloy form say that only when the time comes that no more strings are attached to use of any of the base metals, will they be able to weigh the resulting benefits adequately. In view of the recent WPB survey of uses of the critically light supply of cadmium, the Operating Committee on Aircraft Materials Conservation has further clarified certain provisions of WPB order M-65, as it applies to aircraft, setting forth in detail in what uses zinc will serve as an alternate for cadmium.

Disclosure of a drop in June copper production to 88,526 net tons from more than a hundred thousand tons in March by the Copper Institute has aggravated conditions in that market. Recent information from the Rhodesian copper mine district in South Africa is that artisans there have gone on strike. In Mexico the mine labor situation is, however, reported to have improved, the striking lead miners having gone back to work.

Emissaries of the Bolivian Government are seeking to have the U. S. Government acquiesce in an upward revision of both tin and tungsten prices.

Several Thousand Tanks Now in Army Camps to Be Modernized

Chrysler Will Overhaul and Alter 2000 30-Ton Tanks; Packard Creates Aircraft Engine Development Division

Chrysler Corp. has announced that it will overhaul and modernize 2000 30-ton tanks at its Evansville, Ind., ordnance plant under a new government contract. Machinery for rebuilding the big tanks is being obtained from all available sources, and a school for training workers on the project has been established.

The program contemplates employment of at least 2500 persons over a 10-month period, and it is expected that approximately 1000 of the renovated tanks will be delivered by the end of this year. The tanks will come from Army camps and upon refitting will be shipped to unannounced destinations.

The changeover from small cartridge manufacture to rebuilding large tanks requires moving out all present equipment and will be carried out with little lost time to employes.

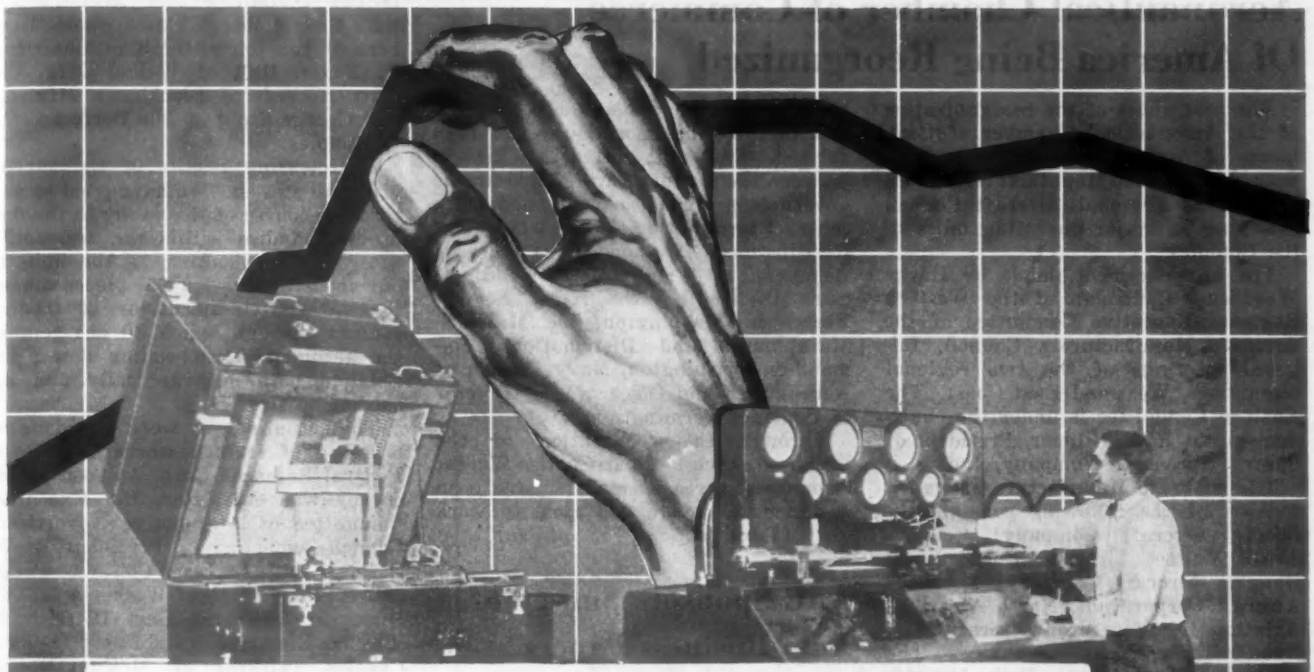
Creation of a special division in its Toledo plant to handle advanced aircraft engine development, has been announced by Packard Motor Car Co. Instituted at the specific request of the Army Air Forces Materiel Command, establishment of the test center will be implemented by a Defense Plant Corp. extension of $1,350,000 to the existing Packard contract.

Work already is under way on facilities, which include dynamometer cells, propeller test stands and special machinery for simulating high altitude conditions. Although specific aims of the program could not be divulged because of security reasons, broad goals have been announced as better aircraft engine performance through increased horsepower, speed and endurance, and reduced weight. C. R. Patton, former chief engineer for Packard, will serve as directing engineer for the development program.

With its last knockdown Liberator bomber completed early in July, all planes produced at the Ford Willow Run plant now are being flown away. The plant was well ahead of its schedule until labor trouble crippled production in mid-July, although the brief shutdown is not expected to put the

(*Turn to page* 52, *please*)

PULLING MAINTENANCE COSTS DOWN WITH INDUSTRY'S NEW RIGHT HAND



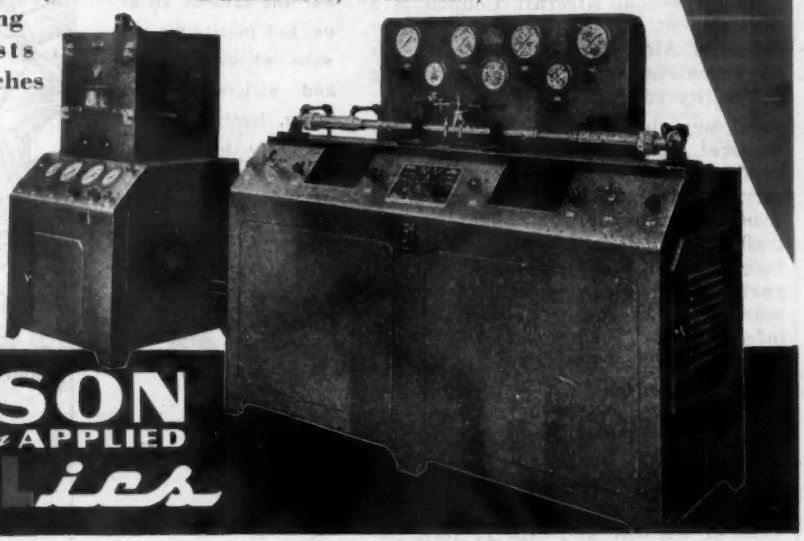
Making leather prove its mettle

Giving leather packings the third degree is the unusual job of this HydrOILic equipment.

The smaller unit tests assembled packings under controlled Fahrenheit temperatures of from 65° *below zero* to 200° above!

The larger unit makes continuous operational cycling tests at pressures up to 3000 pounds per square inch, to determine the life expectancy of packing materials. This special equipment illustrates, in just one way, how HydrOILic Engineering is pulling maintenance costs down in all branches of Industry. It is not only testing materials and equipment, but performing a multitude of production jobs as well.

Through the application of oil-hydraulic control of power and motion, Denison designers have made HydrOILics the key to *new* industrial achievements and *improved* industrial operations. They will be glad to show you how HydrOILics applies to your products or problems. Write to: The Denison Engineering Co., 1178 Dublin Rd., Columbus, Ohio.



DENISON
EQUIPMENT *in* APPLIED
HydrOILics
TRADE MARK

Aeronautical Chamber of Commerce Of America Being Reorganized

The first phase of the reorganization of the Aeronautical Chamber of Commerce of America has been completed with the Aircraft Manufacturers Council and the Personal Aircraft Council emerging as major operating units of the Chamber.

The announcement, made by Harry Woodhead, Chairman of the Western Regional Executive Committee of the Aircraft Manufacturers Council, followed meetings of the two regional committees, West and East Coast. The Eastern Committee is under the chairmanship of R. E. Gillmor, President of Sperry Gyroscope Company, Inc.

The Aircraft Manufacturers Council consists of the following companies—Boeing Aircraft Company; Consolidated Vultee Aircraft Corporation; Douglas Aircraft Company; Lockheed Aircraft Corporation; North American Aviation, Inc.; Northrop Aircraft, Inc.; Ryan Aeronautical Company; The Aviation Corporation; Bell Aircraft Corporation; Curtiss-Wright Corporation; Fairchild Engine & Airplane Corporation; The Glenn L. Martin Company; Republic Aviation Corporation; Bendix Aviation Corporation; The Waco Aircraft Company; Sperry Gyroscope Company, Inc., and United Aircraft Corporation.

The AMC operating pattern is similar to that of the Aircraft War Production Councils and emphasizes regional action of the company presidents forming the two regional executive committees, as well as of the AMC advisory committees in specialized fields.

Each regional executive committee meets once monthly, and action on which the two groups agree becomes the national action of the Aircraft Manufacturers Council. Offices of the Aircraft Manufacturers Council have been established at 7046 Hollywood Boulevard, Los Angeles, and a West Coast Manager shortly will be appointed.

The Personal Aircraft Council is a development of the earlier Chamber Personal Aircraft Committee and has an extensive program for increasing the utility of light airplanes.

Former departments of the Aeronautical Chamber at the Washington headquarters have been reorganized as service bureaus in the following fields: economic, industrial relations, technical, traffic, and public relations. The economic bureau embraces the former departments of economic development, research and statistics, legislation and information. These bureaus will serve the Aircraft Manufacturers Council and the Personal Aircraft Council, as well as the general membership of the Chamber not identified with either Council.

Immediate concern of the Aircraft Manufacturers Council is the development of efficient and orderly termination and reconversion processes. A Contract Termination Unit has been formed. This unit will act as liaison between the manufacturers and various government agencies concerned with contract termination. These include the Readjustment Division of the Materiel Command at Wright Field, Readjustment Division of the Army Service Forces in Washington, the Materiel, Maintenance and Distribution Command in Washington, Navy Bureau of Aeronautics and Office of the Director of Contract Termination.

Through the cooperation of the Lockheed, Douglas and Curtiss-Wright companies, three specialists have been assigned to devote full time to work

(*Turn to page* 152, *please*)

AAC Sponsors Survey of Auto Business Papers

There has just been completed by subscribing members of the Automotive Advertisers Council an intensive survey of the readership of nationally distributed business magazines with editorial appeal directed to the general interests of automobile dealers and independent garages offering maintenance and repair services.

The pattern for the survey was set up by the Council's business paper relations committee and then checked with the membership as a whole. Members of the committee are: Chairman, T. Faxon Hall of Walker Mfg. Co., Burt Hotvedt of Blackhawk Mfg. Co. and George Stout of The Perfect Circle Companies.

In releasing results of the survey, Mr. Hall states: "We have tried to pattern the course of this study to the flow of merchandise within the automotive aftermarket—choosing as the hubs of our investigation typical places among the various classifications of trading centers through which 80 per cent of the automotive wholesaling flows, distributed both geographically and according to size."

The actual survey work was done by a group of trained workers of Ross-Federal Research Corp. As soon as the survey was completed, the Executive Committee of Automotive Advertisers Council consisting of President R. W. Case, Jr., of Thermoid Co., Vice-President T. Faxon Hall of Walker Mfg. Co., Secretary-Treasurer Carl Dietrich of Wagner Electric Co. and Past-President Charles Tapscott of McQuay-Norris Mfg. Co., met at the Chicago headquarters of the National Standard Parts Association with the executive heads of the publishers involved, to discuss with them the findings of the survey before the results were released and to place both publishers and advertisers in a more favorable position to work together toward further strengthening of the business press for even more effective post-war service.

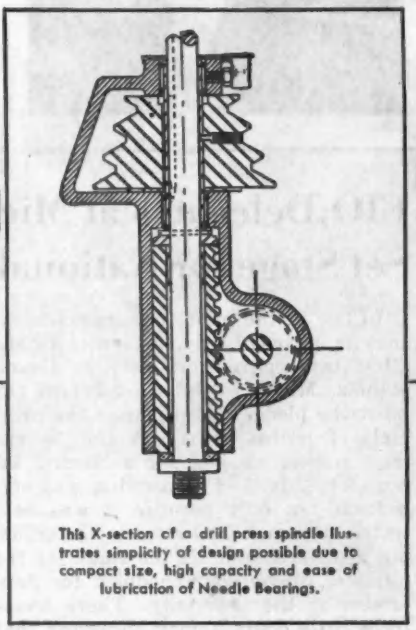
And Try Baiting with Individual Incentive

For the sake of all of us, but mostly for the sake of our soldiers and sailors, let us hurry, hurry, hurry—not only in winning the war but in being ready for the peace.

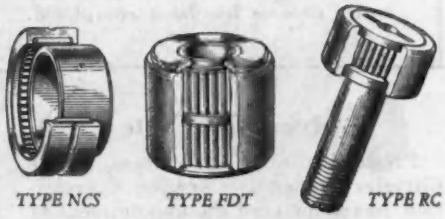
—Bernard M. Baruch and John M. Hancock.

Needle Bearings Aid Design Simplification

TYPE DC *DC (Inner Race)* *TYPE AT*



This X-section of a drill press spindle illustrates simplicity of design possible due to compact size, high capacity and ease of lubrication of Needle Bearings.



TYPE NCS *TYPE FDT* *TYPE RC*

FEATURES OF THESE MODERN ANTI-FRICTION UNITS ALL CONTRIBUTE TO INCREASED OPERATING EFFICIENCY

In almost any application where Torrington Needle Bearings are employed, the design problem is simplified—due to the unusual combination of advantages which these modern anti-friction bearings offer.

The advantage of higher capacity in smaller space, for example, means that smaller, simpler housings may be employed. This in turn means less material is required in the housings, with a consequent reduction in weight and lighter, more compact design of other members is often made possible.

The efficient lubrication of Torrington Needle Bearings is another feature which aids the designer. The retaining raceway which holds the full complement of needle rollers also provides a natural reservoir for retention of the lubricant. Thus, in most designs, need for auxiliary seals and special lubricating systems is eliminated. In fact, in certain applications, Needle Bearings lubricated on installation, will operate entirely satisfactorily without further service attention during the life of the product!

Assembly Also Simplified

Production and assembly problems are also simplified, thanks to the ease of handling and installation of Torrington Needle Bearings. The designer need only provide the simplest type of bearing mount—a bore machined to proper dimensions. Also, as Needle Bearings will not creep or slip, spacers or other locking devices are not necessary to hold them in place under either rotating or oscillating operation.

All of these features contribute to simplification of design—with resulting increases in operating efficiency, longer service life and manufacturing economies that are helping now in meeting wartime production. And they will be of equal value in meeting the demands for the peacetime products of tomorrow. Investigate for yourself the ways in which Torrington Needle Bearings will aid your postwar plans. The Torrington Needle Bearing Catalog 30-A gives more complete information. In addition, the services and experience of our engineering department are available to assist you in securing full advantages of the application of Needle Bearings in *your* products.

THE TORRINGTON COMPANY

Established 1866 • Torrington, Conn. • South Bend 21, Ind.

"Makers of Needle Bearings and Needle Bearing Rollers"

New York, Boston, Philadelphia, Detroit, Cleveland, Seattle, San Francisco, Chicago, Los Angeles, Toronto, London, England

LET'S GO! USE 'EM—KEEP 'EM POWERED

TORRINGTON

NEEDLE BEARINGS

Industrial Merry-Go-Round

This rotating, automatic plating machine is used by the Radio Division of Bendix Aviation Corporation to plate various parts going into their plane radios, direction finders and other devices. The operator places the parts on the machine and, once the plating process has been completed, removes them at the same spot. Rotating automatically, this device progresses through several steps while the plating is going on, dropping parts in different tanks. At proper intervals, the machine lifts the parts from the tanks, rotates and puts them in another tank until the entire process has been completed.

High Rate of Munitions Production at Briggs

Despite the foremen's strike in May which lowered output of airframes, airplane turrets and tank hulls in that month, munitions production at Briggs Manufacturing Co. during the first six months of this year was materially greater than the record output in either the first or second halves of 1943. Shipments through June totaled 64 per cent more than in the same period a year ago and were 20 per cent ahead of the last six months of 1943.

Knudsen Appointed

Lieut. Gen. William S. Knudsen has been appointed head of the AAF Materiel and Services Command.

Advertising Note

President David A. Wallace, of the Chrysler Division, Chrysler Corporation, has announced the appointment of C. C. Lockwood as advertising business manager of the division, reporting to George Miller, sales executive.

Mr. Lockwood, in this position, will be responsible for the business detail of the advertising department. Further consideration will be given to the creative division of the department and to a new method of agency contact and cooperation at a future date, according to Mr. Wallace.

CIO Delegates at Michigan Convention Set Stage for National Meeting

In one of the most tumultuous meetings in labor history, delegates to the CIO state convention, held at Grand Rapids. Mich., in July, reaffirmed the no-strike pledge and espoused the principle of united political action as the most potent weapon for achieving labor's objectives. The meeting was significant not only because it was held in the strongest CIO state in the union, but also because it set the stage for the national convention scheduled for September in the same city. There seems to be little doubt among observers that the principles adopted at the state meeting will be accepted in the main at the national conclave.

Although opposition to the no-strike pledge produced the most fireworks, with a clamorous minority staging a wild demonstration before the pledge was reaffirmed, chief emphasis was on political solidarity. All speakers drove home the idea that the only practical means of attaining the ends sought by labor is to elect to office those candidates friendly to labor. Observers pointed out, however, that the general reaction to a resolution endorsing the CIO Political Action Committee and its plan to seek voluntary contributions of $1 from each member, was far from enthusiastic. There was considerable comment when R. J. Thomas, UAW-CIO president, canceled a speaking engagement at the convention to fly to Washington, under Presidential priority, to answer a summons from Democratic political leaders. Later, labor leaders came out openly in support of President Roosevelt and advocated the renomination of Henry A. Wallace for Vice-President.

Just how powerful labor will be at the polls is still a debatable question; although leaders point to such cases as Congressman Martin Dies, who chose to withdraw in the Texas race when faced with labor opposition, and to the five CIO-backed members elected to the Michigan House of Representatives in the recent primaries, out of a field of nine who had labor support.

Action on demands for wage increases also is foreshadowed at the national convention, predicated on developments at the state meeting. One speaker told the delegates that they should be asking for a 25 per cent boost in hourly rates, together with demands for a guaranteed dollars-and-cents annul wage. A determined fight to break the Little Steel wage formula before election day is predicted by observers.

Obituary

George Carr Purdy, 73, chairman of the board of Greenlee Bros. & Company, died July 2 at Rockford, Ill. He had been associated with the Greenlee organization since 1893. Shortly after joining Greenlee's, Mr. Purdy was made assistant sales manager, and in 1897 was appointed general manager in charge of all operations. In 1902 he was elected secretary-treasurer, and in 1904 moved the company to Rockford, Ill. In 1919 he was elected president, which position he held until 1943, when he became chairman of the board.

H. B. Larzelere, 65, founder of the Vim Motor Truck Co. in 1914, died July 19 at his home at Bird Neck Point, Virginia Beach, Va. During his career in the automobile industry, he also served as sales manager of the Chadwick Engineering Works, as president of the Touraine Motor Car Co., and as California representative of the Packard Motor Car Co.

B-W Superchargers, Inc.

The McCulloch Engineering Corporation, Milwaukee Division of the Borg-Warner Corporation, has changed its name to B-W Superchargers, Inc.

ARMY E NAVY

Awards

Names and winners of Army-Navy "E" awards in or allied with the automotive and aviation industries, announced since the July 15 issue of Automotive and Aviation Industries went to press:

THE PERFECT CIRCLE COMPANY, Hagerstown Plant, Hagerstown, Indiana.

THE PERFECT CIRCLE COMPANY, New Castle Plant, New Castle, Indiana.

THE PERFECT CIRCLE COMPANY, Richmond Plant, Richmond, Indiana.

THE PERFECT CIRCLE COMPANY, Tipton Plant, Tipton, Indiana.

WORCESTER STAMPED METAL COMPANY, Worcester, Massachusetts.

"E" Star Awards

for continued meritorious services on the production front have been awarded to the following firms:

ELECTRONIC ENTERPRISES, INC., Newark, N. J.

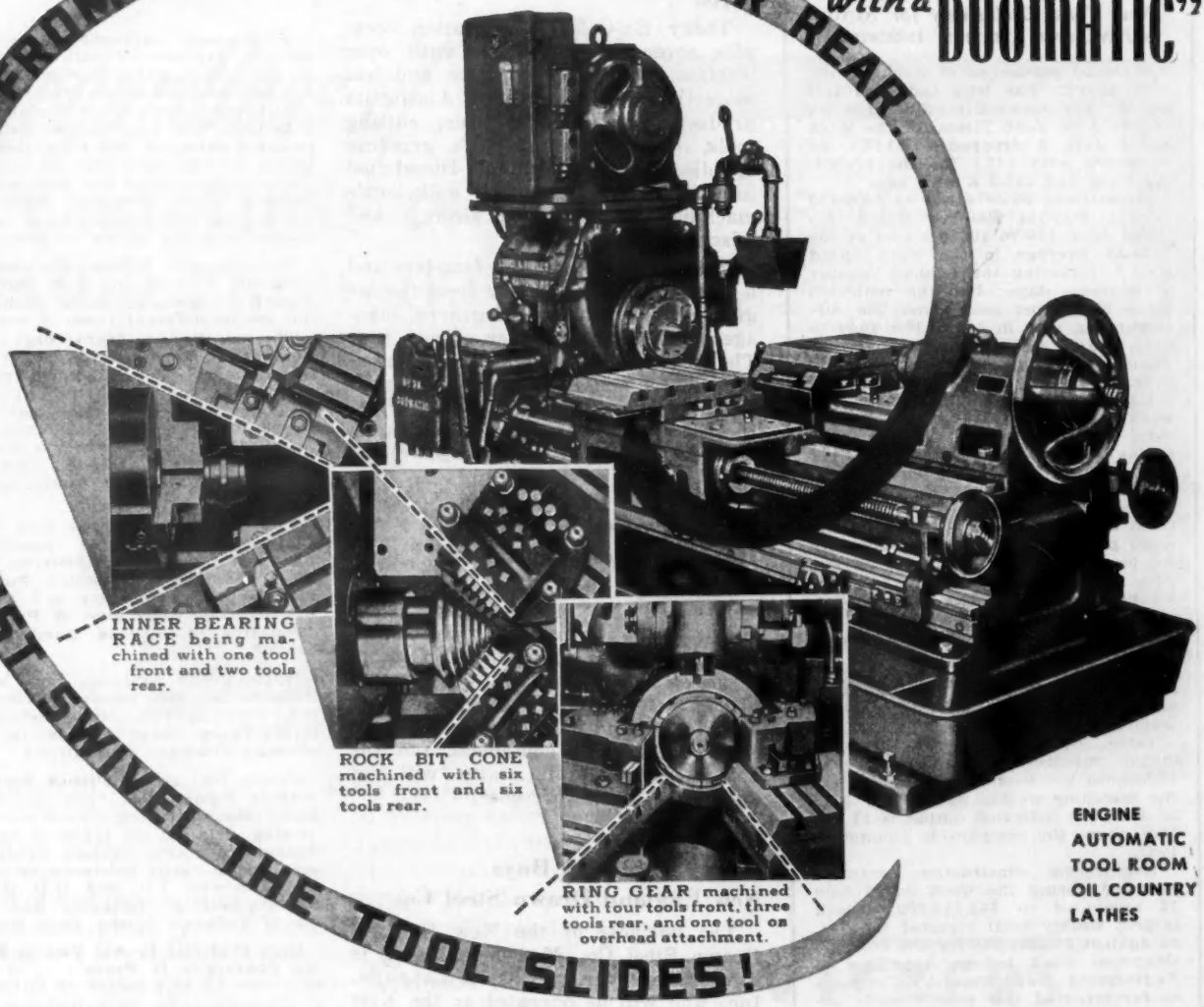
GENERAL ELECTRIC COMPANY, Bridgeport, Conn.

JESSOP STEEL COMPANY, Washington, Pa.

TUBE TURNS, INC., Louisville, Ky.

"You can do it with a DUOMATIC"

TO CUT FROM ANY ANGLE—FRONT OR REAR . . . JUST SWIVEL THE TOOL SLIDES!



INNER BEARING RACE being machined with one tool front and two tools rear.

ROCK BIT CONE machined with six tools front and six tools rear.

RING GEAR machined with four tools front, three tools rear, and one tool on overhead attachment.

ENGINE
AUTOMATIC
TOOL ROOM
OIL COUNTRY
LATHES

TO obtain unlimited cutting angles on the Lodge & Shipley Duomatic Lathe, only the simplest adjustments are required. With the dual carriages and tool slides—front and rear—multiple tools are used in turning and in straight and angular facing operations never before possible with so little effort. The most difficult bevel cuts are performed with remarkable ease.

The massive tool slides of the Duomatic are solidly supported, insuring stability even under heaviest cuts, and are readily swiveled to give a power feed and power traverse movement at any angle. When the tool slide is rotated through an angle of 180°, the direction of feed motion is reversed so that facing cuts travel away as well as toward the centerline.

These outstanding improvements, greatly widening the range of cutting operations, are typical of the many time-saving, labor-saving advantages offered in the Duomatic. As a result, the Duomatic stands unchallenged among automatic lathes for simplicity and adaptability, handling large or small lots with equal facility. For more detailed information, call on Lodge & Shipley Engineers or write on your company's letterhead for Bulletin 601-FL.

THE LODGE & SHIPLEY MACHINE TOOL CO.

CINCINNATI 25, OHIO, U. S. A.

L & S LATHES

Business in Brief

Written by the Guaranty Trust Co. New York, Exclusively for AUTOMOTIVE AND AVIATION INDUSTRIES

Widened fluctuation of general business activity has been indicated this month. The seasonally adjusted index of *The New York Times* for the week ended July 8 dropped to 130.9, as compared with 143.7 for the preceding week and 137.7 a year ago.

Department store sales, as reported by the Federal Reserve Board, declined from 130 to 103 per cent of the 1935-39 average in the week ended July 8, reflecting the reduced number of business days; but the indicated value was 2 per cent above the corresponding sum in 1943. For 1944 to date, the total is 7 per cent greater than the comparable amount last year.

Railway freight loadings during the week ended July 8 totaled 745,141 cars, 17.0 per cent less than the preceding weekly number and 7.9 per cent below the corresponding figure in 1943.

Production of electric power registered a contra-seasonal decline in the same period; and the total was only 0.5 per cent above the output a year ago, as against a similar excess of 5.3 per cent reported a week earlier.

Crude oil production during the week ended July 8 averaged 4,579,000 barrels daily, 7750 barrels below the all-time peak reported a week earlier and 27,100 barrels less than the average output recommended by the petroleum Administration for War.

Estimated production of soft coal during the week ended July 1 was 12,050,000 net tons, barely more than the preceding weekly figure. For 1944 to date, the indicated output is 11 per cent above the comparable amount in 1943.

Engineering construction contracts awarded during the week ended July 13 amounted to $62,510,000, second largest weekly total reported in 1944, as against $18,922,000 for the holiday-shortened week before, according to *Engineering News-Record*. Contracts so far reported this year show a decline of 51 per cent from the corresponding amount in 1943—the drop in public projects amounting to 56 per cent, as against a recession of 13 per cent in private construction.

The Irving Fisher index of wholesale commodity prices advanced fractionally in the week ended July 14 to 113.0 per cent of the 1926 average, as against 111.1 a year ago, registering for the seventh time in 1944 an all-time peak.

Member bank reserves declined $138,000,000 during the week ended July 12, but excess reserves rose $100,000,000 to an estimated total of $1,600,000,000. Business loans of reporting members increased $10,000,000 in the preceding week and stood $472,000,000 above the total a year ago.

Ex-Cell-O Celebrates Silver Anniversary

On July 10, Ex-Cell-O Corporation, Detroit, celebrated its twenty-fifth anniversary. Ex-Cell-O was incorporated on July 10, 1919, having been organized by a few of the workers in the small tools department of one of the large motor car manufacturers in Detroit. At that time the company occupied the second floor of a small two-story building and produced jigs, fixtures, dies, drill jig bushings and a few automotive parts.

Today Ex-Cell-O Corporation occupies several large plants with over 900,000 sq ft of floor space and has more than 10,000 employes. Among its products are machine tools, cutting tools, hydraulic power units, grinding spindles, drill jig bushings, Diesel fuel injection equipment, paper milk bottle machines and precision aircraft and miscellaneous parts.

Phil Huber, one of the founders and a director of the company from the beginning, is president and general manager of Ex-Cell-O. Other officers are: Thor M. Olson, vice-president in charge of sales; James K. Fulks, vice-president in charge of manufacturing. H. Glenn Bixby, secretary-treasurer, and Earl E. Conlin, assistant secretary.

Houdaille-Hershey Acquires Honan-Crane Corporation

The Houdaille-Hershey Corporation has bought all of the stock of the Honan-Crane Corporation, well-known manufacturer of oil purification equipment. Honan-Crane will be operated as a subsidiary of Houdaille-Hershey. The corporation will continue to manufacture the same equipment and the change in corporate status will not affect any of the present policies.

Bliss & Laughlin Buys New England Drawn Steel Co.

The business of the New England Drawn Steel Co., Mansfield, Mass., is being taken over by Bliss & Laughlin, Inc., and will be operated as the New England Drawn Steel Division of Bliss & Laughlin, Inc., under the direction of Harold L. Sherwin, who will continue as general manager, with headquarters at Mansfield, Mass.

CALENDAR

Conventions and Meetings

SAE Natl. West Coast Transportation & Maintenance Meeting, Portland, Oregon	August 24-25
American Chemical Society, New York City	Sept. 11-15
SAE Natl. Tractor Meeting, Milwaukee	Sept. 13-15
SAE Natl. Aircraft Eng. & Production Mtg., Los Angeles	Oct. 5-7
SAE Natl. Fuels & Lubricants Mtg., Tulsa	Nov. 9-10
Motor & Equip. Wholesalers Assn. Convention, Chicago	Nov. 9-11
American Chemical Society Natl. Chemical Exp., Chicago	Nov. 15-19
SAE Natl. Air Cargo Mtg., Chicago,	Dec. 4-6
SAE Annual Meeting, Detroit	Jan. 8-12

PUBLICATIONS

A 44 page catalogue and application manual, profusely illustrated with photographs and sectional drawings, and including pertinent tabulated data regarding the construction, use and adaptation of **Spring Life** high, low and custom built bellows, pressure detectors and indicators has been issued by the Cook Electric Co. Some of the subjects covered are: description of the "Spring Life" principle, charactertistics, engineering advantages, tests, calibration, adaptability and advice on selection.*

The Ingersoll Milling Machine Co. has prepared a chart, 15 x 23 inches, illustrating the **basic grinds for milling cutters** for use on different types of material.*

The new **DoALL Zephyr high speed friction cutting machine** is described and illustrated in a 4-page bulletin distributed by Continental Machines, Inc. The bulletin gives specifications and the high operating speeds of these new machines showing their wide application in the shaping and fabricating of all materials such as light alloys, plastics, wood, rubber and sheet metal.

Two new bulletins have been issued by Surface Combustion for metal-producing and metal-working industries. One is titled, **Surface Combustion Furnaces in the Steel Wire Industry** and the second, **Applied Gas Chemistry of Prepared Atmospheres in Surface Combustion Furnaces.***

Hydro-Power Systems, Inc., has issued Bulletin No. 440, which describes in detail, and illustrates the modern line of **Hydro-Power Gear Pumps** for medium pressure hydraulic application.*

Folder No. 142. **Reliance Spring Lock Washer Folder,** has been issued by the Eaton Manufacturing Co. It covers engineering data on all types of spring lock washers, contains compact general information and ready reference on steel section size and I.D. and O.D. dimensions for engineering, designing and purchasing of Reliance Spring Lock Washers.

Case Histories to Aid You in Blueprinting Conversion to Peace . . . is the title of a new booklet issued by Lamson Corp. It presents some case histories showing results achieved by certain plants in converting to **war,** in order to suggest what results may be accomplished when the time comes to re-convert to peacetime operation.*

The B. F. Goodrich Co. has issued a new catalog section on **Rivnut,** the modern blind fastener which doubles as a nut-plate, rivet or both. A page is devoted to a step-by-step presentation of Rivnut installation. On another page is a chart showing all pertinent details on all types of Rivnuts.*

Fenwal, Inc., has issued a new **Thermal Control** catalog describing more than twenty of the Fenwal products, including installation drawings and photographs for both temperature and pressure control apparatus. A brief history of the company has also been included.*

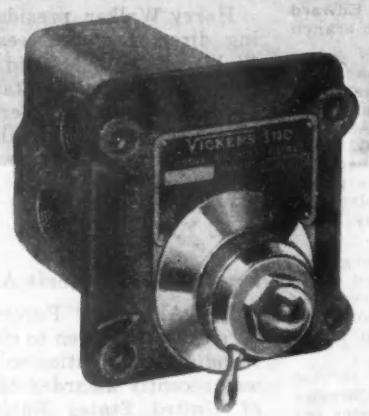
A new engineering bulletin, describing in detail the practical and scientific tests made to determine the effects of using an **antispatter fluid in welding,** has been issued by The Midland Paint and Varnish Co. In addition to other pertinent data, it contains illustrated laboratory reports on tests for determining weld strength and weld soundness.*

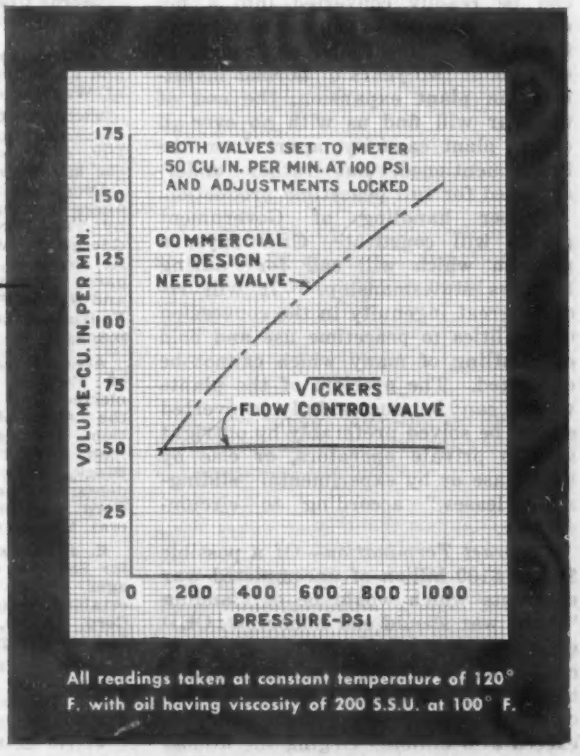
Bulletin No. 25, recently published by The Farval Corp., is called **Farval Centralized Systems of Lubrication.**

* Obtainable by subscribers within the United States through Editorial Dept. AUTOMOTIVE *and* AVIATION INDUSTRIES. In making requests for any of these publications, be sure to give date of the issue in which the announcement appeared, your name and address, company connection and title.

CONSTANT FLOW RATE

Regardless of VARIATIONS IN FLUID PRESSURE





All readings taken at constant temperature of 120° F. with oil having viscosity of 200 S.S.U. at 100° F.

As shown by test chart at right, the Vickers Flow Control Valve maintains a practically constant metering rate (for a given setting of the control adjustment) regardless of variation in fluid pressure. This ability to accurately control the rate of travel of tool head or slide . . . or the rpm of a hydraulically driven work spindle . . . at all times regardless of the resistance encountered is a fundamental requirement of many types of machine tools and special machinery. The absence of a hesitation, jump or a speed variation with a load change is important because these nearly always are detrimental to tool life, work finish or proper operation. Tool damage when "breaking through" work is eliminated and variations in cut or operating pressure have no appreciable effect upon feed rate. See Bulletin 40-15 for complete information.

Vickers Application Engineers will gladly discuss with you how "hydraulics" can be used to your advantage.

VICKERS

Adjustable FLOW CONTROL VALVES

VICKERS *Incorporated*

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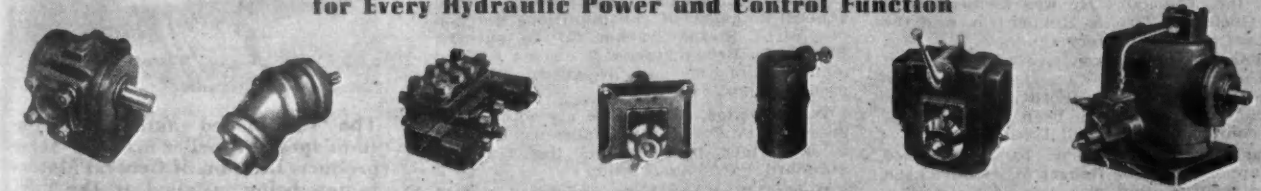
Application Engineering Offices: CHICAGO • CLEVELAND • DETROIT • LOS ANGELES
NEWARK • PHILADELPHIA • ROCHESTER • ROCKFORD • TULSA • WORCESTER

Representative of More than 5,000 Standardized Vickers Units for Every Hydraulic Power and Control Function



CONSTANT DELIVERY PUMPS · FLUID MOTORS · DIRECTIONAL CONTROLS · VOLUME CONTROLS · PRESSURE CONTROLS · CONTROL ASSEMBLIES · VARIABLE DELIVERY PUMPS

Government Surplus

(*Continued from page* 36)

outstanding exception being synthetic rubber.

Probably not more than $5 billions, or about one-third of the $15.5 billion total, can be readily converted into a net effective addition to the nation's peacetime plant. Since $5 billions represent only about two years of normal investment in plant expansion, the end of the war will find us with no over-all excess plant capacity, apart from the lines mentioned, but rather underequipped for full peacetime production.

Proper handling of Government plants will constitute, CED says, a problem which will call for "daring business statesmanship." It will require great ingenuity in the conversion of facilities to peacetime use and bold dismantling of many which cannot be converted. The problem of the plants which can be successfully converted should be solved preferably by outright sale to private operators, or else by long lease or by experimental "sliding-scale leases," according to circumstances.

Contract Termination—Of a possible $80 to $100 billion of uncompleted war contracts which would be outstanding "if the war should end tomorrow, CED estimates that total claims will not exceed a maximum of $10 billion and that the area of possible dispute between contractors and Government will not exceed $1.5 billion. Urging the utmost speed in termination settlement, CED asserts that the cost to the nation of unnecessary delays, in terms of lost production and in morale of unemployed workers, could be vastly greater than any savings which might accrue to the Government.

Sorensen to Receive Stock in Willys-Overland

Following approval by stockholders of an agreement under which he is to receive 100,000 shares of stock at $3 a share over the next five years, Charles E. Sorensen was elected president of Willys-Overland Motors, Inc., July 12. Ward N. Canaday, who will continue as chairman of the board, announced that Sorensen will assume immediate direction of production operations.

PERSONALS

Paul F. Jones has been made assistant general sales manager of Joseph Weidenhoff, Inc., Chicago. He was formerly with the Goodyear Tire & Rubber Co. and the Willard Storage Battery Co.

Henry Ford II, executive vice-president of the Ford Motor Co., has been made vice-president of the Ford Motor Co. of Canada, Ltd. He has been a director of the company since April 1.

Nash-Kelvinator Corp. has announced the appointment of **Robert M. Hendrickson** as sales promotion manager of Nash Service and Parts, with headquarters in Milwaukee.

Kenneth K. Kohnitz has been made regional coach manager by Reo Motors, Inc., to operate under the Philadelphia branch.

Pontiac Motor Div. of General Motors Corp. has named **Latham Clark** manager of the Buffalo Zone. **H. G. Hersh** has been appointed manager of the Memphis Zone.

George Orphal has returned to Detroit as sales executive in the truck department of Dodge Div., Chrysler Corp., after serving as assistant regional manager in New York and executive assistant in the Fargo Div. at Washington since 1941.

Victor D. Orne has been appointed traffic manager of the Flint plants of Chevrolet Div. of General Motors Corp., succeeding the late **Francis A. McHale.**

Promotion of six assistant branch managers to managerships has been announced by The Ford Motor Co. They include: **George T. Montagnet**, New Orleans; **Ray A. Grimmer**, Milwaukee; **Harry M. Lidgard**, Pittsburgh; **John W. Schwer**, Fargo and **Nelson F. Bowe**, Los Angeles. **Edward F. Hughes** has been made assistant branch manager at Richmond, Calif.

Alvan Macauley, Chairman of the Board of Packard Motor Car Co., has been elected, for the 17th term, president of the Automobile Manufacturers Association. Serving with him are **Paul G. Hoffman**, Studebaker Corp., and **Robert F. Black**, White Motor Co., both vice-presidents; **George W. Mason**, Nash-Kelvinator Corp., treasurer, and **Albert Bradley**, General Motors Corp., secretary.

E. J. Johnston, formerly service engineer for Shell Oil Co., has been appointed manager of the new district office recently established in Detroit by the Nox-Rust Corp. **N. J. Mollhagen** has been made technical engineer.

W. B. Rice has been appointed service manager of Plymouth Div. of Chrysler Corp. He has been with the Chrysler organization since 1937.

Merrill C. Horine has returned as Mack sales promotion manager following his resignation from the WPB. For the past year Mr. Horine has been research consultant to the director of the Automotive Division of the WPB, with offices in Washington.

Norma-Hoffmann Bearings Corp. has announced the election of **Frederick W. Mesinger** as a vice-president, succeeding **H. J. Ritter**, who resigned. Announcement has also been made of the election of **D. E. Batesole** as vice-president and chief engineer. Mr. Batesole has been a member of the company's engineering department for more than twenty-five years, and chief engineer since 1937.

Norton Co. has announced that **Ralph O. Anderson** has been named district manager of the newly formed sales territory to be known as the West Central Rocky Mountain District, with headquarters in Denver.

Frank R. Pierce, who has been manager of the Detroit office of the General Motors Public Relations Dept., has been transferred to an assignment on the personnel staff of the Corp. **John E. Johnson**, who has been director of training service in the General Motors War Products Dept., will succeed Mr. Pierce as head of the Detroit Public Relations office, under Paul Garrett.

Sherrod E. Skinner, general manager of Oldsmobile and vice-president of General Motors Corp., has been elected a life trustee of the Rensselaer Polytechnic Institute.

Clarence L. Wanamaker has been named general manager of the munitions division of United States Rubber Co. to succeed **Ernest G. Brown**, recently chosen general manager of mechanical goods, general products, etc.

W. C. Dodge, Jr., has been elected vice-president of Ferodo and Asbestos, Inc. He is a former president of the National Standard Parts Association.

Dudley Rice has been appointed a field engineer in the Chicago district for the Eutetic Welding Alloys Co.

Westinghouse Electric & Mfg. Co. has announced the appointment of **Edgar B. Karns** as manager of the street and aviation lighting application section. **Charles A. Powel**, manager of headquarters engineering of the Westinghouse company, was elected president of the American Institute of Electrical Engineers for the year beginning August, 1944.

A. Kinkler Prins has been made manager of the New York district sales territory of American Machine and Metals, Inc.

The Aro Equipment Corp. has announced the appointment of **J. E. Neff** to the headquarters staff to assist in the merchandising of Aro Lubricating Equipment.

F. F. Sampson, manager New York branch, The Electric Storage Battery Co., has retired after thirty years of service. **Daniel P. Orcutt**, assistant manager succeeds Mr. Sampson as manager.

Distribution in Spain and Spanish Possessions

Harry Walker, president and managing director of Autocessorios Harry Walker, S. A. of Madrid and Barcelona, is now in the United States to make arrangements with American manufacturers seeking distribution in Spain or trade with Spanish possessions. Mr. Walker can be reached c/o Messrs. Bolton & Mitchell, 79 Wall St., New York 5, N. Y.

Dayton Wins Merit Award

The Army Air Forces new Civilian Merit Award, given to civilians for outstanding contribution to the war effort, was recently awarded to D. D. Dayton of United States Rubber Company's airplane tire division in recognition of valuable work done by Dayton while attached to Wright Field as airplane tire specialist.

PRECO Incorporated

The Pacific Railway Equipment Co., Los Angeles, Cal., has changed its name to "PRECO Incorporated." The business, management and personnel remain unchanged.

Aeroprop on Mustang

The four-bladed automatic, constant speed propeller made by Aeroproducts Division of General Motors is now being installed on the P-51 D, an improved version of the Mustang plane.

The CONE AUTOMATIC MACHINE COMPANY sees many GOOD THINGS AHEAD

It is reported that . . . . . .

Vibrating chisels, similar to those used to break up pavements, are being tried out by dentists as an improvement over the familiar drill.

get ready with CONE for tomorrow

The rare metal, tantalum, unknown forty years ago, is being used in bolts, screws, and plates to repair the broken bones of wounded soldiers.

get ready with CONE for tomorrow

A gas-filled fuse, now used to detonate mines, will explode a charge three and one-half miles away in one second. It can be used under water and is itself a powerful explosive. Laid in a line cross-country, it will instantly clear a path through trees and brush or dig trenches.

get ready with CONE for tomorrow

A low priced ultraviolet lamp bulb is ready for the after-the-war market.

get ready with CONE for tomorrow

A noted aviation engineer and successful industrialist has plans for a revolutionary helicopter that uses a contra-rotating propeller, carries four passengers, and can be operated on a highway.

get ready with CONE for tomorrow

A new heat-resistant alloy is reported that uses silicon and manganese to replace part of the scarce nickel and chromium formerly used.

get ready with CONE for tomorrow

Fireproof cotton batting is now being made for upholstery and insulation.

get ready with CONE for tomorrow

A new iron is being made which has as much as five times the tensile strength of ordinary cast iron. With it, even cast iron springs can be made.

A plant has been built for processing large quantities of the lowly milkweed. The floss is a good substitute for kapok in upholstery, an oil for paint is made from the seeds, wallboard can be made from the stalks, and latex extracted from the leaves.

get ready with CONE for tomorrow

A new machine checks the size of ball bearings at rates as high as 20,000 per hour.

get ready with CONE for tomorrow

New sleeping cars have a triple deck arrangement of berths.

get ready with CONE for tomorrow

The "electric eye" can now be used to detect and warn of dangerous gases in the air.

First post-war models of television sight and sound receivers are expected to sell at from $200 to $700. Reception will about equal in quality the familiar 16 mm. motion pictures.

get ready with CONE for tomorrow

A new cream protects those of our Navy who are exposed to the risk of flash burns.

get ready with CONE for tomorrow

Coilsprings of Nylon, while not as strong as steel, will function indefinitely without breaking from "fatigue."

get ready with CONE for tomorrow

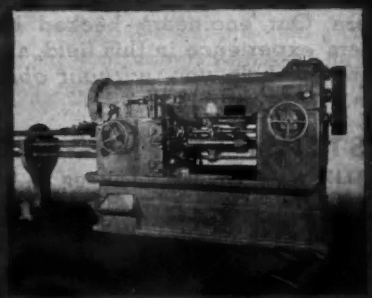
A new rubber sheeting perforated with 6,400 holes to the square inch is being used for filters.

get ready with CONE for tomorrow

A new microscope converts an invisible ultra-violet image into a visible full color picture without the use of photography or fluorescent screens.

You'll need production like this in the days AHEAD

THIS speedometer pinion blank is made of cold rolled steel and has a hole 1" deep in one end. It is produced in 10 seconds on a 6-Spindle Conomatic.



CONE

AUTOMATIC MACHINE CO., INC. ★ WINDSOR, VERMONT, U. S. A.

8

Tanks Now in Army Camps to Be Modernized

(*Continued from page 42*)

program behind the quota. In answer to published reports that the Willow Run plant might be converted to a warehouse after the war for storage of surplus war materials, Ford officials have stated that the company expects to exercise its option to purchase the property for manufacturing purposes. While not definite on what product would be made, a spokesman said it might be planes of the passenger or cargo type, of tractors and other farm equipment.

Chevrolet Division of General Motors Corp. has turned out more than 113 million pounds of aluminum aircraft forgings to date in its four plants and now is rated the second largest producer of these aircraft components. The company's entire magnesium production, totaling more than 3 million pounds since the beginning of the war, is used by Chevrolet in building Pratt & Whitney engines for Liberator bombers and for C-47 and C-53 transport planes. Forgings range from engine parts to 8-ft propeller blades. One plant turned out more than 30,000 propeller blades a month, and another produced approximately 200,000 separate items monthly.

The Hudson Motor Car Co. has disclosed that it now is building armored cabins for the new P-63 fighter plane. Although power, speed, range and armament of the new plane have not been revealed, it has been described as a larger and improved version of the P-39 Airacobra.

Since it started work on manufacture of Sperry marine gyro compasses for the Navy 20 months ago, Dodge Division of General Motors Corp. has turned out enough of the instruments to supply a fleet of more than 4000 ships. Mass production of the compass, which weighs approximately 600 pounds, has been accomplished despite the fact that many parts require manufacturing operations of higher precision than that required for watch work. The first pilot model came off the line in July of 1942, and by the end of the year more than 100 of the units had been shipped. Two months ago, production of the compasses was doubled. They are used chiefly on naval vessels up to the destroyer class.

Three General Motors divisions have received contracts for production of heavy artillery ammunition under the Army's expanded program. The Oldsmobile Division at Lansing, Mich., the Pontiac Motors Division, Pontiac, and the Fisher Body Division, Grand Rapids, are included among 56 companies receiving contracts for 155 mm, 8-in. and 240-mm shells.

Manpower continues to plague the arms production program in general. The Army has announced that during the April-May-June quarter production of war materials fell 8 per cent behind schedule. Medium tanks, tank destroyers, bulldozers and heavy-duty trucks were included in the list of deficient items. Stating that manpower is the chief bottleneck in the munitions program, Robert P. Patterson, Acting Secretary of War, scored what he called "a prevalent but grossly mistaken feeling that the war is about over." He also pointed out that the lag in schedules is aggravated by constant revision of schedules—mostly upwards—brought about by demands from commanders in combat areas.

Splash Curtains for Industrial Machines

Splash curtains for the protection of machine operators are one of the new uses for transparent sheets of compar—the flexible rubber-like synthetic made by Resistoflex Corporation, Belleville, N. J. Large sheets of compar, a vinyl resin derivative that is entirely immune to oils and solvents, are mounted on frames and installed between the operators and their machines. Since the compar is completely transparent, performance of machines is visible at all times, and in addition operators no longer run the chance of getting dermatitis from contact with oil.

SYMBOLS of SERVICE

By WESTERN

Every felt shape on this page is doing essential service on some product—excluding dirt, dust and grit, retaining lubricants, cushioning shock, insulating against heat and noise, isolating vibration, filtering, etc. And new uses for this versatile material are being discovered daily!

Western produces felt to take full advantage of its special properties: resiliency, flexibility, compressibility, resistance to heat, age, oils, alcohol, etc. Western's felt sizes and shapes are produced to the closest tolerances, to meet your requirements.

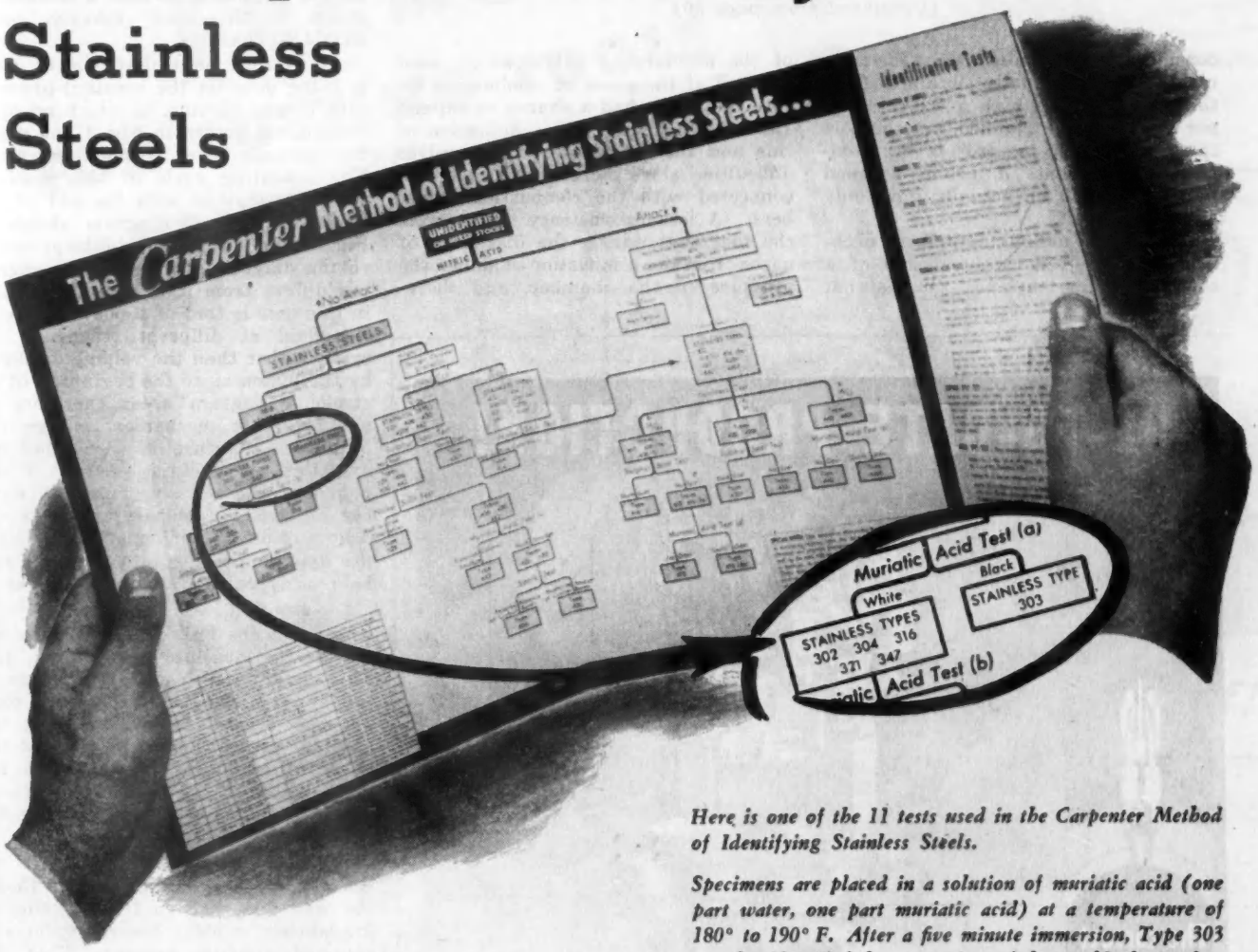
If you have any problem involving the possible use of felt, take it to Western. Our engineers, backed by 45 years' experience in this field, are prepared to help you, *without obligation*. Write us today.

WESTERN FELT WORKS
4035-4117 Ogden Avenue - Chicago 23, Ill.
Branch Offices in All Principal Cities

Acadia Synthetic Division, Western Felt Works, Processors Synthetic Rubber, extrusions, sheets, molded parts.

WESTERN Felt
Largest Independent Manufacturers and Cutters of Wool, Hair and Jute Felts

To Help You Identify Stainless Steels



Here is one of the 11 tests used in the Carpenter Method of Identifying Stainless Steels.

Specimens are placed in a solution of muriatic acid (one part water, one part muriatic acid) at a temperature of 180° to 190° F. After a five minute immersion, Type 303 can be identified by a coating of heavy black smudge.

Even in the best regulated plants, steel stocks sometimes do get mixed. And if the stock happens to be Stainless Steel, you know the troubles a mix-up can cause in heat treating, machining, stamping, welding or other fabricating operations. So it's important to you to have a quick method for identifying Stainless that may become mixed in stock.

To help you meet this problem, the Carpenter Laboratories have developed a new and simplified chart for identifying various types of Stainless Steel. The chart diagrams and explains the nitric acid test, magnet, spark, hardness, and muriatic acid tests, sulphur spot and nickel spot tests, and the stabilization test, and shows when and how to use each one. By closely following the instructions on the chart, it is possible to check the identity of Stainless Steels which may be in question.

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Gas Turbine Development

(*Continued from page* 30)

considerable uncertainty as to the thermal efficiency actually obtained from these turbines; as high a figure as 23 per cent has been claimed, but the best fairly authentic record is approximately 13 per cent. A turbine designed to develop 1000 hp actually gave only 450 hp.

There are a number of difficult problems to be solved in the design of a constant-volume turbine. One is that of the discharging valve, which must pass all of the gases of combustion before they have had a chance to expand (and therefore to cool). Actuation of this and the inlet valve also involves difficulties, since there is no crankshaft connected with the combustion chambers. A loss in efficiency arises from the fact that during the discharge of gases from the combustion chamber the pressure in the chamber, and therefore the velocity of the jet, varies continuously, and for maximum efficiency the jet velocity must bear a definite relation to the blade velocity, hence should be constant.

At present most development work is being done on the constant-pressure type of gas turbine, of which an illustration was shown in Fig. 1 and which has already been briefly described. The operating cycle of this machine can be explained with the aid of the "pressure-volume" diagram shown in Fig. 3. This corresponds to the pressure-volume diagram of a piston-type engine, but differs from it in that the volume in this case is that of a pound of working fluid at different stages of the cycle, rather than the volume displaced by the piston since the beginning of its stroke. Diagram areas therefore do not represent mechanical energy imparted to the turbine wheel; but the available or potential energy of one pound of the working fluid. A number of constant-temperature lines are drawn in on the diagram. These lines are hyperbolae, and data for them can be readily calculated by the equation

$$v = (170 - 0.37\,T)/p \text{ cu ft},$$

where T is the Fahrenheit temperature and p the absolute pressure in psi. This equation also gives the value of the abscissa for point A where compression begins, for which point the absolute pressure p is 15 psi and the temperature 60 F. To find data for other points of the compression curve AB we make use of the equation for adiabatic compression,

$$p\,v^{1.4} = \text{constant}.$$

As at point A p has a value of 15 psi abs. and v of 12.8 cu ft, the value of the constant is 533. Therefore, for any assumed absolute pressure p of the gases the corresponding volume is

$$v = \text{antilog}\left(\frac{\log 533 - \log p}{1.4}\right)$$

Thus we find that at the end of compression, for instance, when the pressure is 60 psi abs., the volume is 4.76 cu ft. The corresponding temperature we find from the equation

$$(460 + T)\,v^{0.4} = \text{constant}$$

As at point A the value of T is 60 deg. and that of v, 12.8 cu ft, the constant is equal to 1444, from which we get

$$T = \text{antilog}(\log 1444 - 0.4 \log v) - 460$$

Beginning at point B the temperature of the working fluid is raised by combustion at constant pressure. At constant pressure the volume of the fluid increases in direct proportion to the absolute temperature, and the volume at 1000 F therefore is

$$\frac{460 + 1000}{460 + 313} \times 4.76 = 9.00 \text{ cu ft.}$$

From C on the fluid expands adiabatically through the turbine to point D, where the pressure is again equal to 15 psi abs. Points on the expansion curve CD can again be calculated by the equation $p\,v^{1.4} = \text{constant}$, after the value of the constant has been determined from the pressure and volume at point C. Also, the temperature at point D is found in a manner similar

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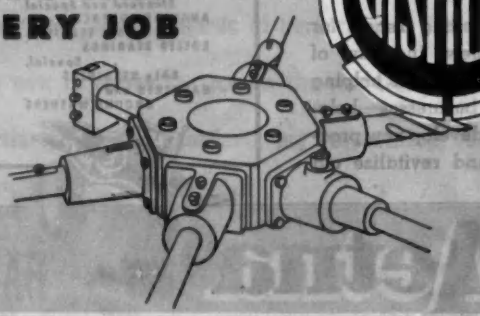

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to that by which the temperature at *B* was determined. At *D* the working fluid, now at atmospheric pressure and a temperature of 523 F, is discharged to the atmosphere.

It will be seen that in the turbine the gas expands from about 9 to about 24 cu ft, or 15 cu ft, and that its pressure drops from 45 psi gage at the beginning to 0 at the end of expansion, the average pressure being about 17 psi gage. Now assume that the gas, instead of being raised to 1000 F, is raised to 1500 F (point *G*), and is then expanded to *H*, where it has a temperature of 860 F. In this case the gas expands from about 12 cu ft to about 32.5 cu ft, or 20 cu ft. As the initial and final pressures are the same as in the previous case, the mean pressure also is the same, and the amounts of energy liberated therefore are in direct proportion to the increases in volume, namely, 15 and 20.5 cu ft. The turbine powers in the two cases, that is, the gross powers, should be in this same proportion of 15 to 20.5. The power absorbed by the compressor is the same in both cases, and if that amounts to two-thirds of the gross power when operating at 1000 F, then the net power will be 5 units at 1000 F and 10.5 units (or more than twice as much) at 1500 F. By thermodynamic reasoning it can be shown that the gross power of the turbine varies directly as the absolute temperature of the gases at the turbine inlet.

Regeneration

There is a great deal of heat energy in the exhaust from the turbine, and a considerable fraction of this heat can be recovered by the process of regeneration. Referring again to Fig. 3, it will be seen that if the gases enter the turbine at 1000 F, they are discharged at 523 F. Since they leave the compressor at 313 F, their temperature must be raised 687 degrees. If all of the heat in the exhaust above the 313-deg level could be transferred to the air leaving the compressor, it would raise the temperature of the air 210 deg. In other words, it would supply about 30 per cent of the heat needed to raise the air temperature to 1000 F. That, however, would require a heat exchanger of enormous size. In practice, 15 per cent of the total heat required is about all that can be recovered from the exhaust gases. Transfer of the heat from the exhaust to the incoming gases is effected in a heat exchanger inserted between the compressor and the burner. A certain drop in pressure results from passage of the air through the heat exchanger; this must be made good by the compressor, which thus must compress to a slightly higher pressure, and consequently it will consume more power. To minimize this loss, care must be exercised in the design of the regenerator to keep the resistance to air flow a minimum.

A further gain in economy can be effected by intercooling the air as it is being compressed. It was shown in the foregoing that the work of compression increases with the initial temperature of the air. As compression proceeds, the temperature of the air rises, and the compression process therefore is less efficient in its later stages. This can be avoided by dividing the compressor into two or more stages through which the air passes successively, and inserting an intercooler between successive stages. An intercooler is merely another form of heat exchanger in which the air gives up some of its heat to water circulating through passages separated from those for the air. When the air enters each stage of the compressor at the same low temperature, the power required to drive the compressor is reduced, and the overall efficiency of the cycle is correspondingly increased. The number of compressor stages and intercoolers is limited by practical considerations. According to F. K. Fischer and C. A. Meyer of the Westinghouse Company, a single stage of intercooling reduces the power required by the compresor by about 15 per cent. They also state that when operating at 1200 F turbine inlet temperature, the practical limit on heat recovery from the

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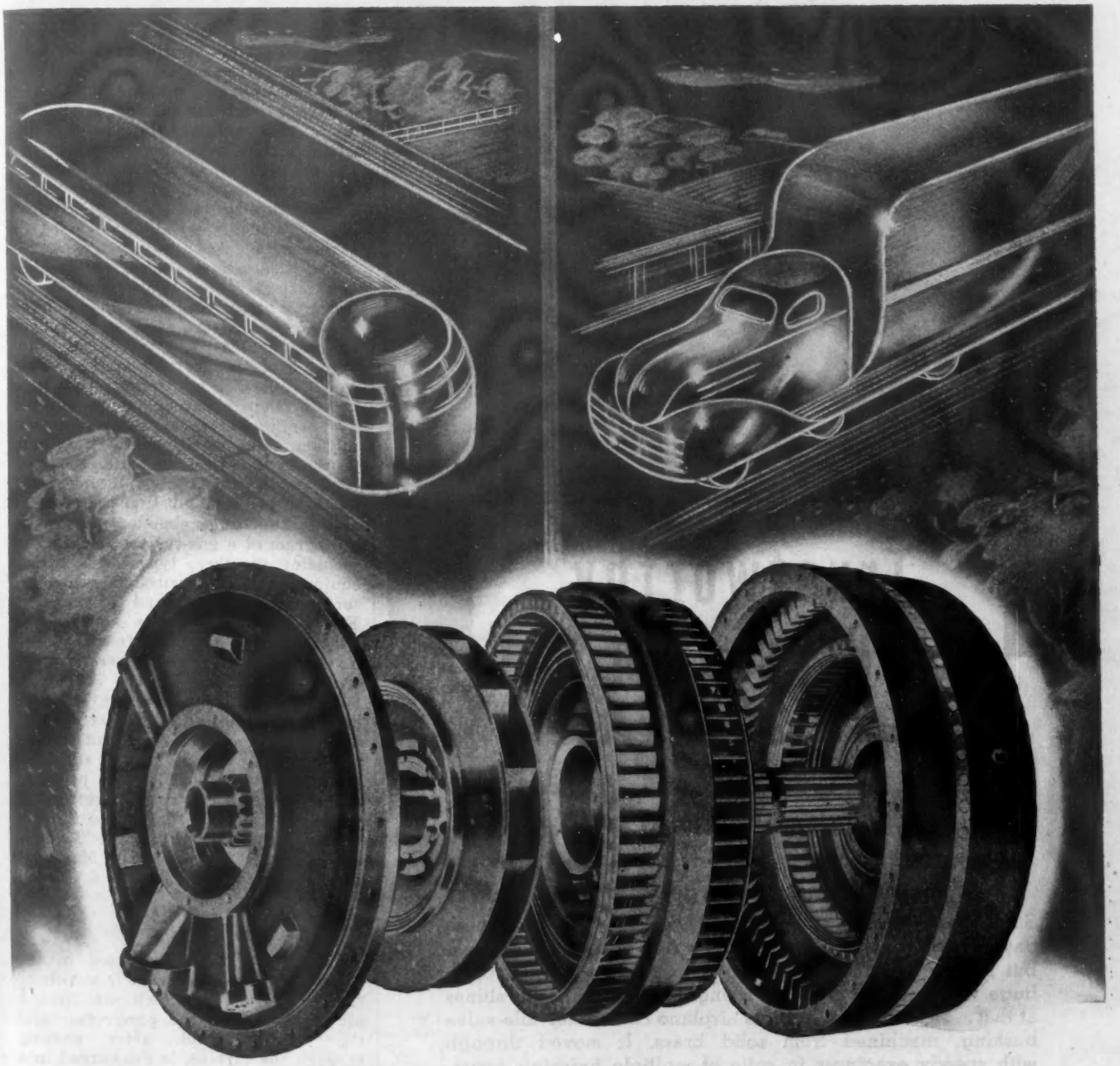

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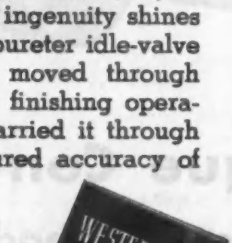

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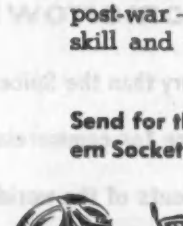

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exhaust (regeneration) is limited to about 75 per cent of the available heat.

Gains in economy can be effected also by reheating the working fluid as it passes through the turbine. It has already been explained that the efficiency of the turbine is the greater the higher the temperature of the gases, but that a limit is imposed on the operating temperature by the limited hot strength of the blade material. In axial-type turbines the gases always are expanded through successive stages, and in each stage there is a temperature drop. Since all of the blades are made of the same material, the "hot strength" of the material is not fully taken advantage of in the later stages. This can be remedied by "reheating." In a gas turbine, reheating can be effected by burning fuel in a passage connecting one stage to the next. It is only necessary to inject fuel into the passage, as the working fluid consists of about 85 per cent air, and therefore is able to support combustion. Fig. 4 is a diagram of a gas-turbine installation including the three types of auxiliary equipment just described, a regenerator, an intercooler, and a reheater. Fig. 5 shows the gains in efficiency which may be expected from the use of these auxiliary units, over an inlet-temperature range of 1000 F-1500 F. The curves are based on an assumed turbine efficiency of 85 per cent, compressor efficiency of 84 per cent, burner efficiency of 100 per cent, air inlet temperature of 70 F and a pressure drop of 5 per cent in the regenerator. Figs. 4 and 5 are reproduced from a paper on The Combustion Gas Turbine by F. K. Fischer and C. A. Meyer of the Westinghouse Electric & Manufacturing Co.

Closed Cycle

The gas turbines discussed in the foregoing operate on what is known as the open cycle, in which atmospheric air is taken into the compressor and the working fluid, after passing through the turbine, is discharged into the atmopshere. Some work has been done also on a closed cycle, in which the same working fluid is continuously recirculated. One advantage of such a cycle is that a high initial pressure can be used, and if the pressure multiplication in the compressor remains the same, the final (absolute) pressure and the mean pressure will be increased in the same proportion as the initial pressure, hence the power output of the turbine is correspondingly increased. In such a system, however, the gases leaving the turbine must be cooled before they enter the compressor. Cooling of the exhaust gases is effected in a heat exchanger which takes the place of the condenser in a steam system. A power plant of this type is being built by the Swiss firm of Escher-Wyss. In this system the working fluid is heated by external means, and the gases of combustion therefore do not pass through the turbine. The heater operates on the same

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general principle as a steam boiler, but for a given power it must have a materially greater heating surface, because this surface is in contact with gaseous media on both sides. In addition to the possibility of using higher pressures, the closed system with external combustion offers the advantage that a cheaper fuel, such as coal, can be burned, as there is no chance of ashes getting into the turbine.

A turbine of the closed-cycle type is under development also by the Westinghouse company, and Fig. 6 shows the arrangement diagrammatically. It is planned to use a compressor inlet pressure of 150, and a turbine inlet pressure of 600 psi. Internal combustion is used, and while the bulk of the working fluid is recirculated, enough fresh air to support combustion is being supplied continuously by a separate small turbine-compressor unit. The small set also serves to maintain the pressure in the main system. The various items of auxiliary equipment are applicable to this as well as to an open system. It seems to be the plan to run this turbine also on solid fuel, for it is stated that solid matter from the fuel must be removed from the gases before they enter the turbines.

Applications

The two principal immediate applications envisioned by those now doing development work on gas turbines seem to be in the railroad and marine fields. One thing that makes the railroad field rather attractive is that the thermal efficiency of the locomotive engine (steam) is relatively low, and could be readily equaled with a gas turbine. Of course, the turbine is non-reversible, and either hydraulic or electric drive would have to be used. Use of such a drive would have the incidental advantage that the turbine could be operated at constant speed, a speed most favorable to high efficiency.

Fig. 7 is an illustration of a 4500-hp gas-turbine power plant for a locomotive, designed by the General Electric Co. It comprises a single gas-turbine unit with a regenerator and waste-heat boiler. Electric drive is used. All axles are motored, and the locomotive is said to have more power per ton than equivalent locomotives using other types of prime mover. To start the gas turbine, the waste-heat boiler is fired separately and then supplies steam to the turbine. Steam from this boiler is available also for train heating in passenger service and for boosting in freight service. The gas turbine is geared, through double-reduction gearing, to two tandem-mounted d-c generators, which permits of operating the turbine at a speed insuring satisfactory fuel economy. In mountainous territory the locomotive can be braked "dynamically" by merely shutting off the fuel supply to the burner. The compressor is then driven by the locomotive, and the energy absorbed by it is discharged to the atmosphere with the air.

The power plant referred to in the preceding paragraph comprises a single-stage turbine of the impulse type. While it is realized that this type does not operate at as high an efficiency as a multi-stage axial compressor, it is preferred because it permits of the use of a higher turbine inlet temperature. This is due to the fact that, since expansion takes place in a single stage, the temperature of the buckets is much lower than the inlet temperature, whereas in a multi-stage turbine there is no great difference between the inlet temperature and the temperature of the first-stage blades.

One advantage of the gas turbine in the marine field would be that it weighs much less than a steam plant of equal output. The thermal efficiency of modern marine steam power plants ranges around 25 per cent, and it is felt that this could be equaled without difficulty if use is made of the various auxiliary equipment tending to increase the economy of operation. However, for maneuvering purposes an electric drive probably would have to be used, unless a practical marine propeller for large powers should be developed.

(*Turn to page 64, please*)

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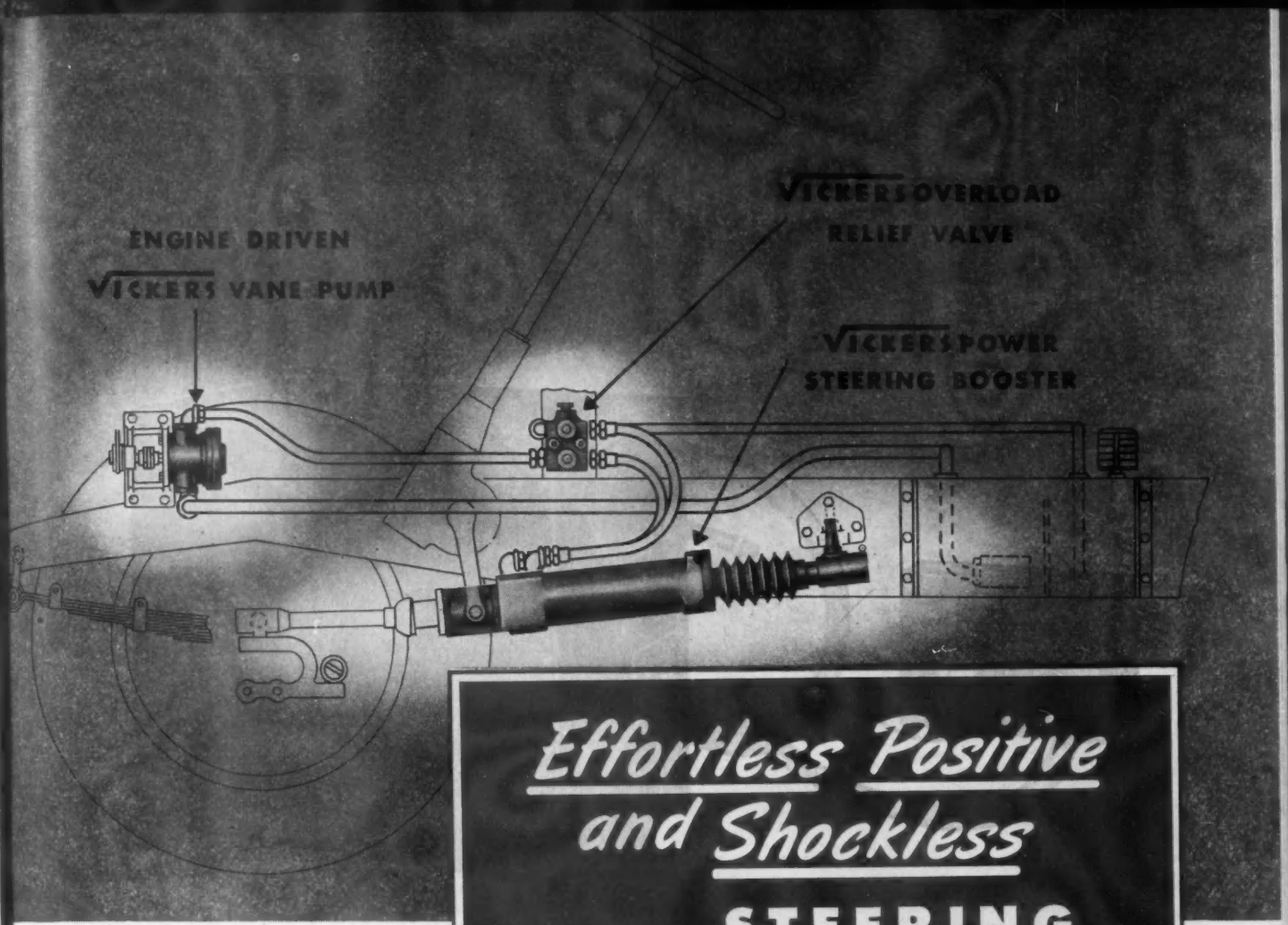

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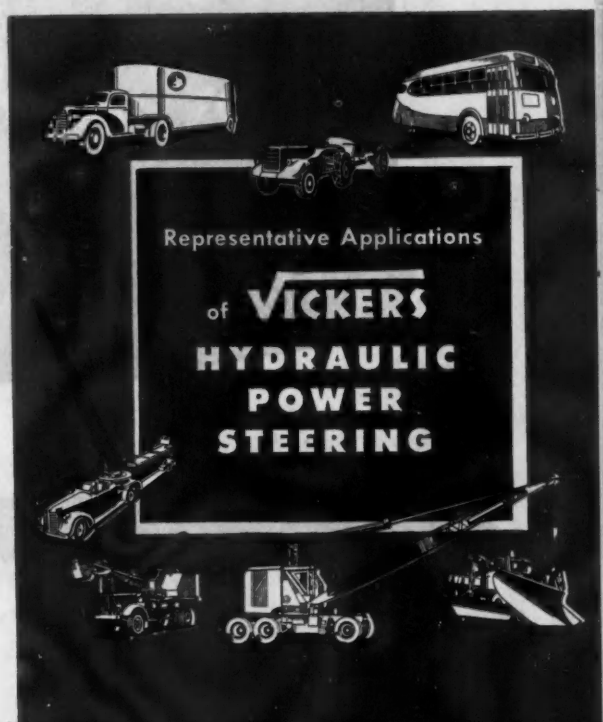

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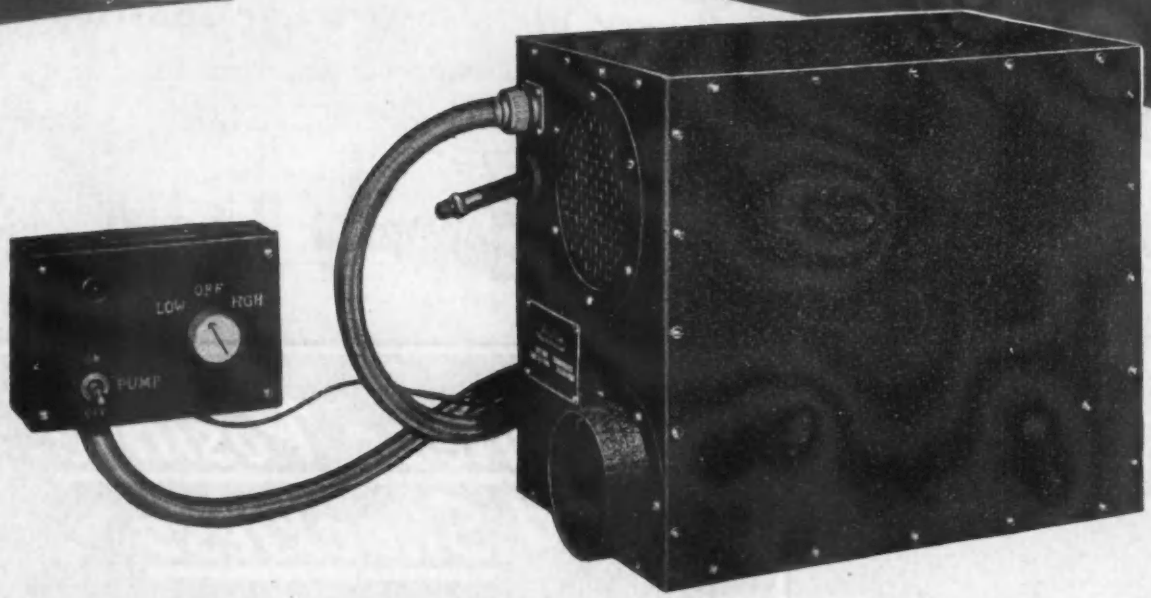

Fluid Heat's New Model SAH-20 "Under the Hood" Truck Heater

This heater has a maximum output of 20,000 BTU per hour, yet weighs only 21 pounds, fits easily under the hood of any truck. Overall dimensions are 7¼ inches wide, 10½ inches high, 12 inches long. To insure clearance, heater can be placed in almost any position. Pump enclosed in the unit draws fuel direct from the truck's fuel tank. All models operate on 6, 12 or 24 volts D. C. or 110 volts A. C. Model SAH-40, not shown on these pages because it is identical in design, delivers 40,000 BTU per hour. It is 13 inches by 10½ inches by 19 inches, weighs only 40 pounds.

(at left)

Fluid Heat's Model SAH-15T

Designed for trailer and cargo-space heating, this model has an output of 15,000 BTU per hour and has a convenient hand-replenished fuel tank compactly built onto the top. Built-on tank makes the heater a completely independent, self-contained unit, permitting uncoupling of trailer without fussing with fuel lines.

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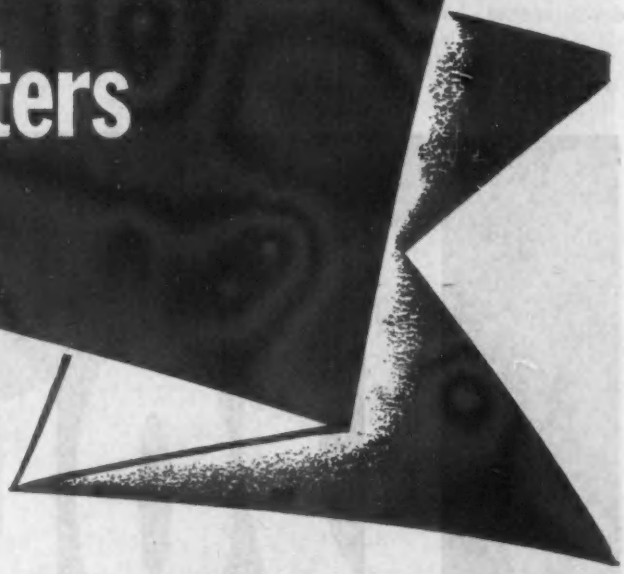

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Most recent writers on the subject of gas turbines also make reference to its possibilities in the aircraft field. It is quite likely that the demand for larger aircraft power units will continue, and a call for units of from 5000 to 8000 hp is anticipated. With the present type of aircraft engine such large outputs could be obtained only from an excessively large number of cylinders, and cylinder multiplication is not conducive to reliability. With a simple turbine it would seem to be impossible — unless metallurgical developments should yield materials of greatly increased hot strength and make possible the use of much higher inlet temperatures—to equal the thermal efficiency of the modern aircraft engine. Heat exchangers added to the turbine to improve its economy would necessarily have considerable bulk, and would be likely to add materially to the frontal area and to the drag. On the other hand, it would be possible to use a fuel that is both cheaper and safer than the high-octane gasoline now required, and this advantage might compensate for a certain inferiority with respect to thermal efficiency.

New Products

(*Continued from page* 41)

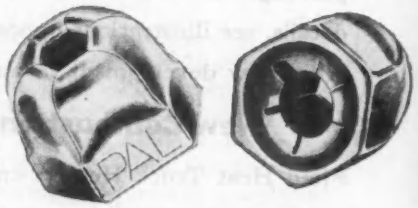
Long-Afterglow Phosphorescent Pigment

A new phosphorescent pigment, which is said to emit a brighter phosphorescent afterglow for a longer period of time than similar long-afterglow pigments, has been placed on the market by The New Jersey Zinc Sales Company, New York, N. Y. This pigment, designated CaS-SrS-2470, is specifically intended for use in such wartime applications as phosphorescent paints, marking tapes and decalcomanias, but should find many peacetime uses.

New Type Self-Locking Palnut

A Palnut with a triple grip has been added to their line of locknuts and fasteners by The Palnut Company, Irvington, N. J. This is known as Type 6NAO. The base of this nut is like a standard Palnut, with six spring steel jaws. When the Palnut is tightened, its arched slotted jaws close in all around the bolt like the jaws of a chuck. Spring tension is also exerted upward on the bolt threads and downward on the nut base, securely locking the Palnut to the bolt. This is the regular double locking action found in all Palnuts.

In type 6NAO Palnuts, however, a third grip is exerted on the bolt by the top portion of the Palnut. The sides of the Palnut have been extended up



Type 6NAO Palnuts

and in, similar to the acorn Palnut in shape, but instead of having a closed top, the ends of the "petals" are turned in, leaving a hole in the top slightly smaller in diameter than the outside diameter of the bolt.

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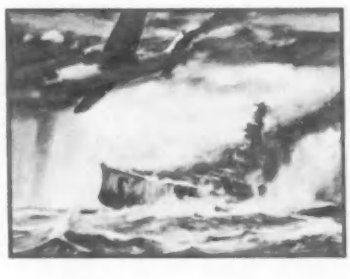

Artist Sessions painted the picture (see reverse side) of the sinking of a Jap battleship by Captain Colin Kelly shortly after the incident occurred, and before authentic details were available. Plane shown is a Douglas B-18; should be a Boeing Flying Fortress B-17C.

Copper Brazing—Production

(*Continued from page* 35)

fractions of one per cent. Heat is used up in the process and it is therefore necessary to add heat continuously to the carbon to maintain the correct atmosphere. This heat is provided by the combustion of gas and air, which also forms the flue gas required in the process. The Drycolene producer unit is shown by Figs. 2 and 3.

Surfaces to be brazed must be clean and free from foreign metals which would interfere with producing a properly brazed joint. In other words, plated parts must be stripped before brazing and the practice of heating sheet metal parts in zinc pots for forming may introduce difficulties in brazing.

Grease, dirt, oxide films and scale should be removed from parts before introduction into a furnace. Oxide films are reduced in the controlled atmosphere and rusted parts introduced into the furnace come out absolutely cleaned, although the practice of brazing such parts is not advisable.

In order to insure capillary action, the faying surfaces must not be highly polished, and there should be good metal to metal contact. Therefore, final cleaning of the parts consists of pickling or sandblasting. Fortunately the as-received or machined surfaces of aircraft parts may be copper brazed after a soil-removal treatment.

Design For Copper Brazing

The basis of all successful brazing is engineering design. Parts must be correctly designed in order to do a reasonable job. The best possible design for copper brazing is a telescopic joint employing a dimetrical clearance of .001 to .003 in. per in. of diameter. One basis for a good tight fit is that the shear strength of copper is 20,000 psi. The tighter the fit the higher the shear strength, and shear strengths as high as 65,000 psi have been realized with shrink fits.

Generally speaking, the time spent on assembly of shrink fits does not warrant their use. The close fit on large diameter parts requires very careful machining and there is always a danger of galling the parts on assembly. Consolidated Vultee Aircraft Corp. did braze a part with a .02 in. diametrical interference on a 2½ in. bore. The parts were put together by heating the shaft to approximately 300 F and refrigerating the liner in dry ice. This is a somewhat risky operation for production runs because if the parts jam it is rather difficult to correct the assembly.

Copper will alloy with the steel to form a copper iron constituent at the inner-surfaces. This can be noted by Fig. 4. A press fit telescopic joint placed in the furnace without any copper will, after being exposed to the brazing temperature, result in a joint with a shear strength in excess of 2000 psi. From this it is reasoned that a solid solution exists at the temperature of 2000 degrees.

It is desirable that wherever possible, copper brazed joints be designed for shear only, inasmuch as the impact resistance in tension in the brazed joint is very low. Another reason for using telescopic joints is that it is rather difficult to fixture parts in the furnace at elevated temperatures, and telescopic joints are self-fixturing, although some assemblies have been manufactured and clamped together with cast iron clamps for the brazing cycle. Another method of holding assemblies together is to tack or spot weld the parts, but it must be remembered that copper will flow through any defect and the spot weld should be very lightly made. Arc tack welding must be carefully done in order not to expand the joint and change dimensional tolerances.

A brazing mixture may have an average shear strength of 24,000 psi

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but the strength is influenced by several factors and should not be used in design. Instead, the value of 10,000 psi should be assumed as the ultimate shear strength. This value of 10,000 psi appears very low to the design engineer but a careful examination indicates that this figure does not prohibit any engineer from using copper brazing.

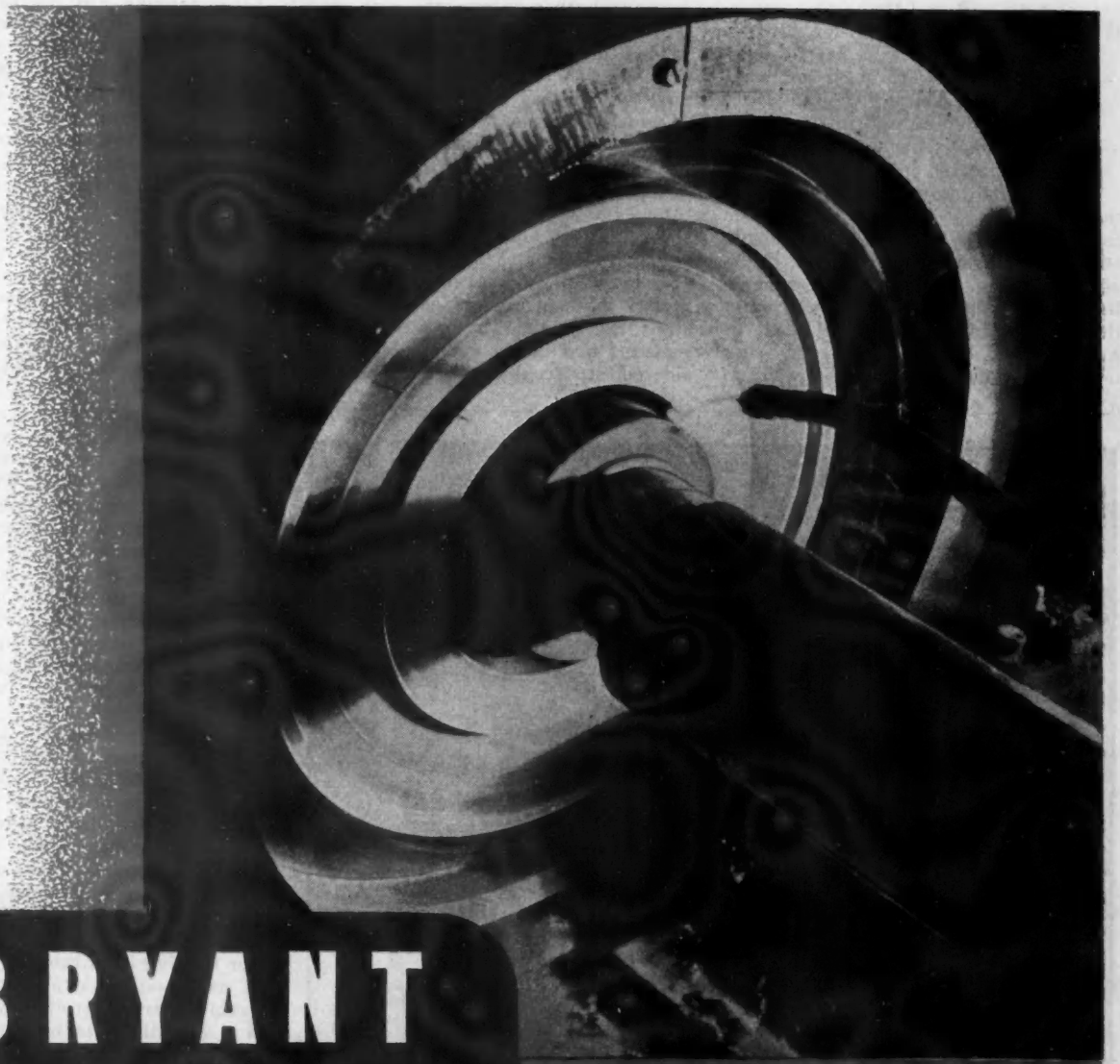
Engineers neglect the fact that the design value is balanced against a safety factor. In other words, perhaps a safety factor of 4 is used in a given design because it has been shown by actual service conditions to be the safe figure for brazed joints. Now if an attempt is made to increase the allowable shear value, is it not in order to increase the safety factor? For instance, 10,000 divided by four equals 2500 lb. If it is intended to increase the design value to 40,000 psi this value of 40,000 psi should be divided by a safety factor that will give the same answer of 2500 psi, namely sixteen.

Several attempts have been made to increase the allowables on design for various aircraft alloys. Here again the problem is the same, since due to past experience with aircraft design, the Army and Navy have designated certain safety factors. Now, if the allowable design value is increased, there is no question but that the Army and Navy will be forced to increase the safety factor accordingly. Therefore, the net gain is zero.

Other Methods Of Welding

At present in the aircraft industry, there are two main welding processes in use for aircraft steels; these are resistance and fusion welding. The fusion welding process is subdivided into two types, gas welding and arc welding. At present, there is a decided preference for arc welding because it is a faster production method. Both gas and arc welding require specially designed fixtures and jigs for positioning the work; but since torch welded parts shrink to a greater extent than arc welded parts, jigs used for gas welding cannot always be substituted for those necessary in arc welding. In view of the fact that a highly skilled operator is required to produce a good weld, aircraft welders must be recertified at regular intervals. With any welding process it cannot be assumed that two pieces of metal can be joined without regard for size, shape or gage thickness. Difficulties are experienced in welding thin to thick material and material under .050 in. should not be arc welded. Places not readily accessible and complicated assemblies composed of many small parts are very difficult to weld.

A comparison of the strength of fusion welding with furnace copper brazing indicates that welded joints of aircraft tubing and sheet are generally designed so that most or all of the load is carried in shear. The formula for determining allowable load as given by the commercial specification ANC-5 is:



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$$P = Ltf_s$$

Where P = allowable load in lb
L = length of weld in in.
t = gage of thinnest material joined by lap welds
f_s = constant multiplied by ultimate tensile stress, expressed in psi.

Considering normalized SAE 4130 the value for f_s is 43,200 psi on the basis of 90,000 psi ultimate tensile strength. Considering a sheet thickness of .040 in. as the thinnest gage in the joint, we find by using this formula that the strength per lineal inch of weld is 1720 lb. Therefore, in order to obtain sufficient length of weld to meet strength requirements, it is necessary to fish tail most of the aircraft welded telescopic joints. In the case of brazing, fish tailing is not necessary and the existing shear area involved is usually sufficient. It has been discovered that with telescopic joints designed for welding, copper brazing can in most instances be directly substituted. Parts so designed have sufficient shear area to lower the calculated design value somewhat below the allowable 10,000 psi. In other words, copper brazed joints using present welded designs exceed the strength of the assemblies and therefore have been considered structually sound. The table accompanying Fig. 6 gives tension test results of copper brazed control rod assemblies. This control rod joint consists of .375 in. OD by .035 in. chrome moly steel tubing joined with a standard AN forging. In all cases, failure occurred in the tubing and not in the copper brazed joint. The control rod assembly is a typical aircraft design that has been both fusion and resistance welded.

In steel welding the alloy element which is apt to cause the most difficulty is carbon. Carbon in small quantities will produce a hardening effect; therefore pre-heating and heat treatment are essential on chrome moly steel which introduces another operation not necessarily required in copper brazing. Steels having a carbon content greater than 0.35 per cent are usually not recommended for welding. This restriction has existed for some time and ordinarily 4140 with 0.40 per cent carbon is not recommended for welding. As a general rule, it is best to keep carbon low in alloy steels in order to produce the best welding results. These restrictions do not exist with copper brazing; high speed steels having a carbon content over one per cent have been copper brazed.

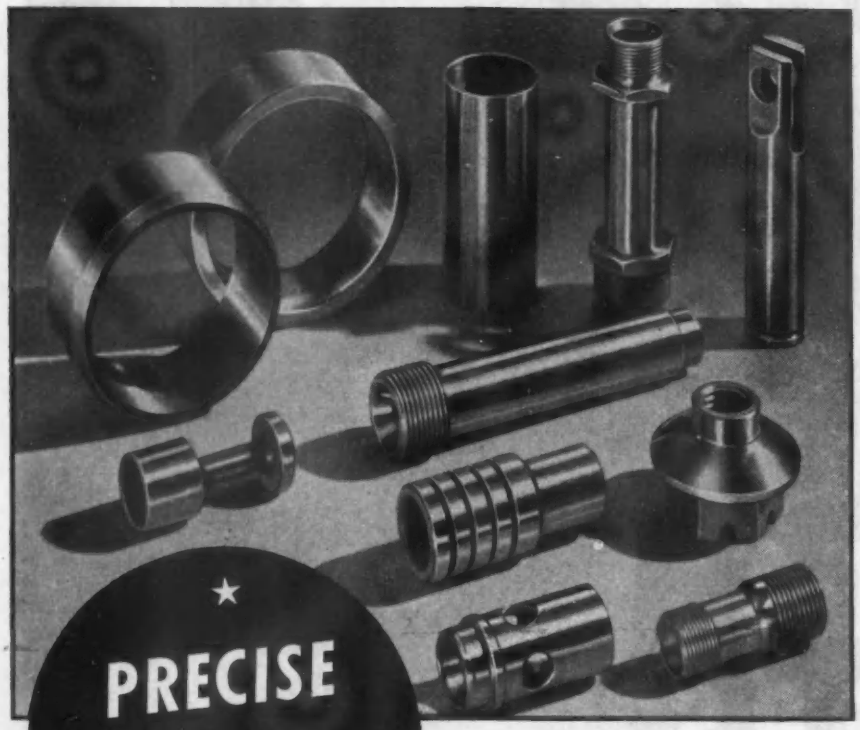
Copper brazing has advantages in tooling, inspection and capital investment. In the case of copper brazing, the joints are ordinarily telescopic and pushing one piece inside the other against a stop, controls the length of the finished part. There are not expensive dies to manufacture and sufficient area may be utilized in the joint to insure 100 per cent joint efficiency. Copper brazing is suitable to a multiplicity of parts without expensive tooling. The variables are controlled by instrumentation and there is nothing left to the manual skill of the operator.

Furnace Brazing Alloys

Although it is possible to use a brazing alloy having a melting point just above the normalizing temperature of 4130 steel, it is believed much better to braze with pure copper and reheat for normalizing or heat treatment to a higher tensile. Brazing alloys melting at lower temperatures than copper usually contain zinc which is highly volatile and has an unstable melting point, or alloys containing tin which are likely to be more brittle than copper brazed joints. In general, best strength and all around results are obtained by furnace brazing with pure copper.

Penetration of copper through the joint is effected by capillary action. Copper has the wetting action of alcohol at a temperature of 2000 F. Under the circumstances, it is necessary only to place the proper amount of copper in the form of a ring, powder or globule near the joint and if the parts have been properly cleaned the copper will be attracted through the joint, appearing on the other side as a fillet. Naturally, this capillary action will be

(*Turn to page 74, please*)



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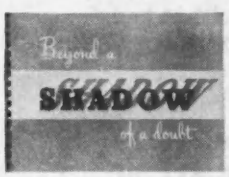

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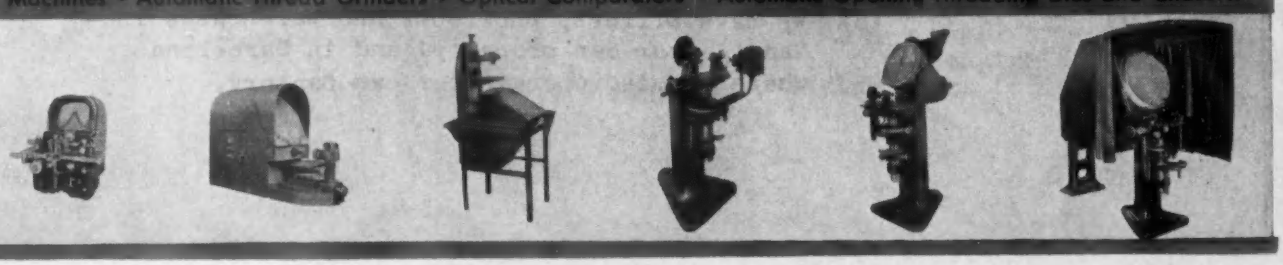

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broken by any irregularity such as a deep machine mark in the joint. This phenomenon of capillary attraction control works to a good advantage; the copper may be stopped by chamfering one end of the telescopic joint. Tests made at the San Diego Division have indicated that copper will flow against gravity for a distance of at least six inches.

Several other brazing alloys have been used such as Cu-Ni, Cu-Ni-Fe, Co-Cu, and Cu-Ag. Experiments have been tried with these alloys for two reasons; to increase the shear strength of the joint and, particularly with the one per cent silver copper alloy, to increase the wetting action. It is understood that the Swiss have used this silver alloy to a great extent on their armament work. Switzerland has carried the art of copper brazing through its entire industry, primarily for the reason that most of the steel used in Switzerland has been imported from Germany and the finished products have been exported to other countries. Under these conditions where scrap losses cannot be tolerated they cannot afford to waste steel by machining excess quantities; the alternative method for preventing waste is to build up sections requiring no machining, a characteristic feature of copper brazing.

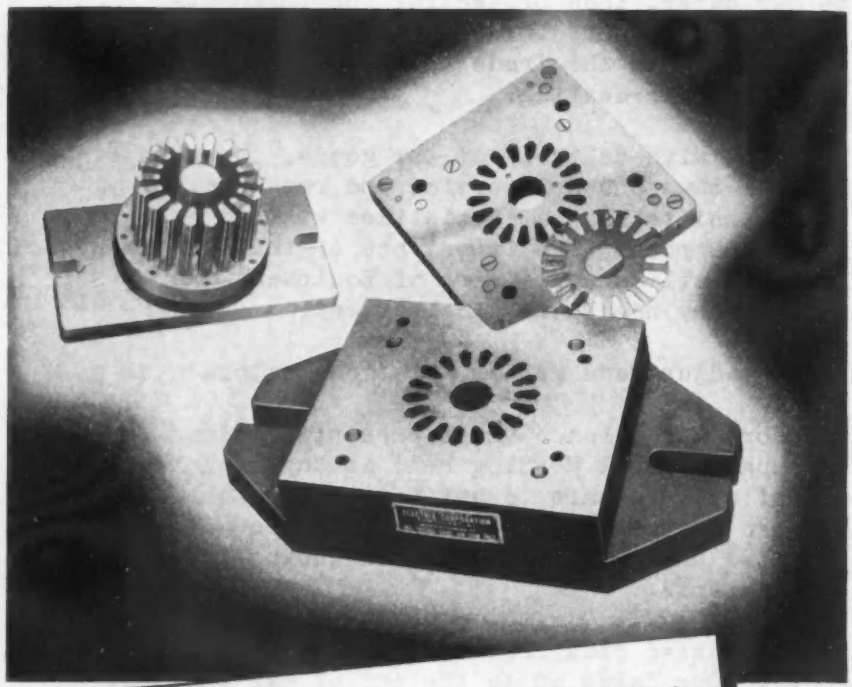
An additional reason for using copper is that a flux to assist the wetting action is required for high zinc or tin brazing alloys. There are several dangers inherent in the use of flux; first the application of flux depends on the skill of the operator who may not apply it satisfactorily; second, there are quite a few proprietary fluxes and some homemade ones that get "batched up" in the shop, with no certainty of results; third, there is always a danger of residual flux being trapped in the joint, resulting in voids, low strength brazes, and a tendency toward corrosion. There has been considerable discussion concerning the electrolytic effect of copper and steel in conjunction with corrosive atmosphere. Copper, being cathodic to steel, tends to force the steel into solution. The steel part endeavors to form a protective coating over the copper. Fortunately, most of the steel parts in aircraft are plated by either zinc or cadmium and therefore the zinc or cadmium surfaces are exposed to the atmosphere and are not subject to electrolytic action as is inevitable between copper and steel. At this time, it might be well to mention that parts should be processed immediately after brazing because the steel coming from the reducing atmosphere furnace is in a nascent condition, and will corrode rapidly in air.

For further protection in resisting service conditions, steel parts are given a protective treatment with paint. Brazed joints in the part naturally receive the same protective treatment. With the limited experience we have had there has been no indication of corrosion other than that normally expected.

In reference to Fig. 4, photomicrograph of X4130 copper brazed, close examination of the structure reveals a diffusion of the copper into the chrome moly steel forming a copper iron alloy. In the "as brazed" condition, the diffusion is not as great as after normalizing. It is well to note that copper produces a good keying action between the parts to be joined. In the third illustration of Fig. 4, it is evident that a harder structure has been induced with further migration of the copper constituent into the iron alloy. A colored photograph would illustrate these boundary lines to a better advantage, as was noted by visual microscopic examination.

Sheet Stampings vs. Forgings

Aircraft design and construction are singular because of the importance of lightness and strength. Many attachments are required such as brackets, clips, plates, clamps, and rods, which fall into the general classification of fittings. A great many of these are made of steel because of the concentrated load and limited stress areas. The use of steel forgings has increased



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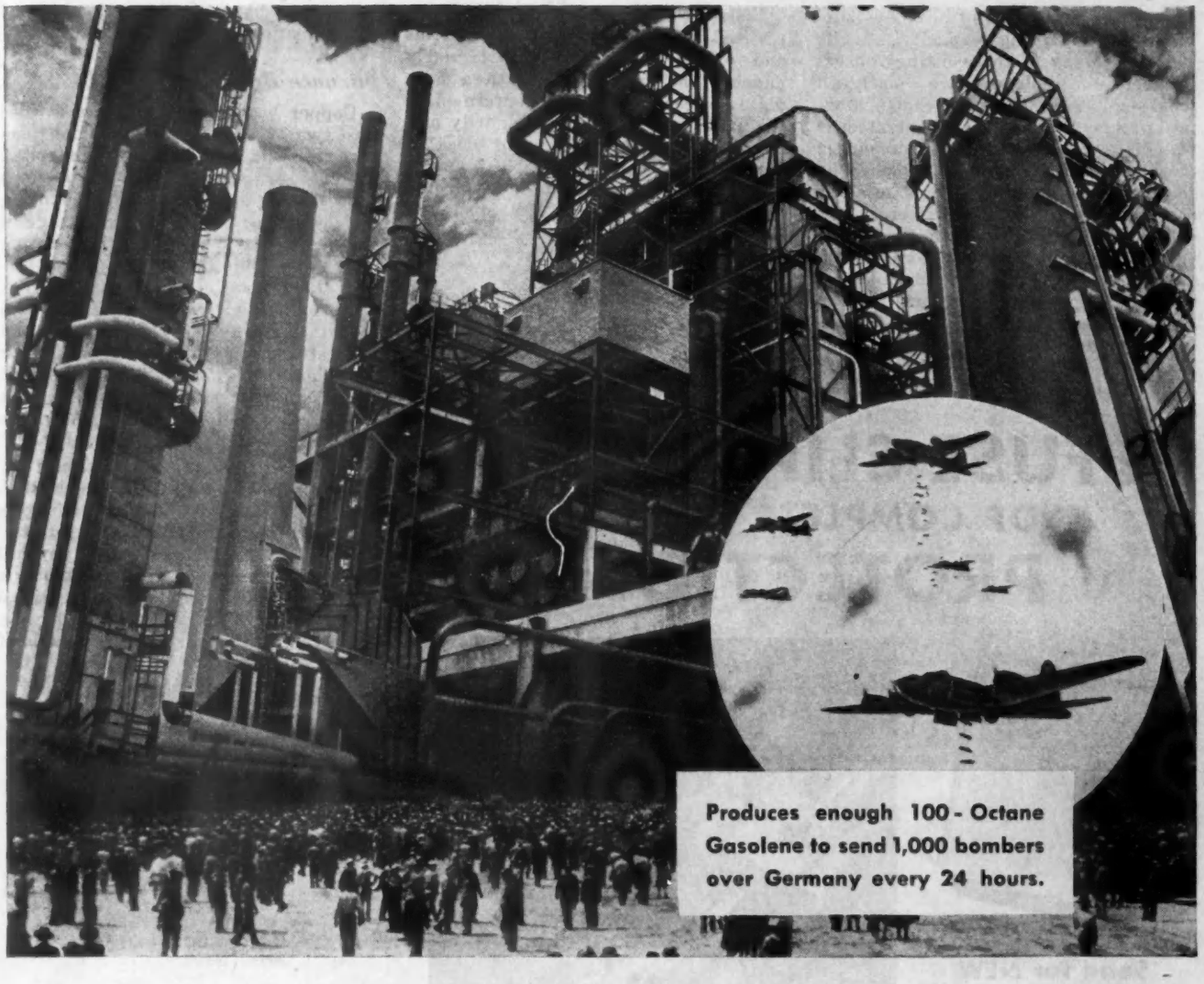

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in the last few years until it has surpassed the forging capacity of the country. Many of these fittings on experimental airplanes are machined from solid stock. After the copper brazing process had been investigated it was discovered that a large percentage of these forgings could be replaced by sheet metal stampings. This may be accomplished without any increase in weight or loss of strength through a slight change in design. On one job in particular, the cost of the brazed article was 50 per cent less than for the design utilizing forgings welded to tubing. This assembly is shown by Fig. 5.

Considerable cost saving has been realized in the manufacture of tools and dies by brazing, particularly punches that are fastened to a base plate. Where impact loads were high, the punch assembly was ordinarily machined by profiling on a solid block of tool steel. It is now possible to make the punch separately and to machine this very readily from tool steel and copper braze it onto a cold rolled plate. Here again considerable machining time is saved.

From these items of technological improvement, it is evident that modern furnace copper brazing equipment may be made a sharp-edged cost-cutting tool of production.

Furnace Brazing Cycle

Copper brazing furnaces are divided into two or three zones in which temperatures can be individually controlled. Common practice involves the use of a pre-heating zone, a brazing chamber, and a cooling zone. The advantage of pre-heating is to raise the temperature of the assemblies slowly enough to prevent distortion due to unequal heating. The cooling zone can be used as a normalizing zone and this temperature regulated to the proper degree for air quenching of 4130 steel. This last phase is important because it eliminates a second normalizing operation with a resultant saving in time and labor.

The "Widmanstatten" obtained by cooling chrome moly steel from the high temperature to approximately room temperature in the furnace is satisfactory from the standpoint of physical properties, compared with the structure ordinarily obtained by conventional normalizing. This is illustrated by Fig. 4, and values are given in the table of Fig. 6.

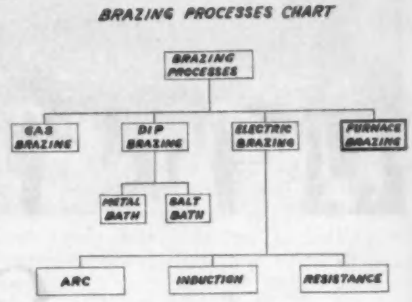

Figure 9

Suitable heat treats on 4130 cannot be obtained by quenching from the copper brazing temperature. But by cooling below the critical temperature, and reheating through the critical, the grain size of the structure is changed and the results obtained from this heat treatment are comparable to heat treated steel which has not been through the brazing cycle.

Time is the fourth dimension of furnace brazing. In order to establish the time of operation, a sample part must be run through the furnace to determine the belt speed settings. Usually this value is ascertained by experience, and examination of the part, in order to determine the flow of the brazing alloy. Ordinarily, aircraft parts are of light weight sections and only short time cycles are required.

This variable may be found by calculating the mass and determining the time cycle from a chart. A cycle of 45 minutes is sufficient for most aircraft

THE FUSE CLIP IS A VITAL PART OF COMPLETE CIRCUIT PROTECTION

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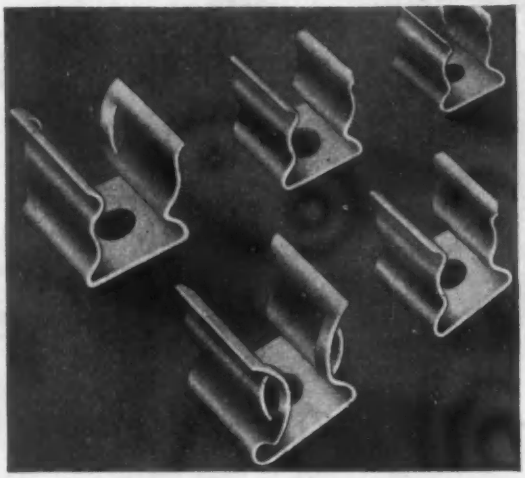


Littelfuse FUSE CLIPS

Phosphor Bronze, Nickel-Plated, and Beryllium Copper, Silver-Plated

In Littelfuse the science of the Fuse Clip has kept pace with that of the fuse itself. This is absolutely necessary to meet dependably the many new efficiency factors of complete circuit protection today—in electrical industry, in electronics, in communications, in radio and television, as well as in aircraft, ordnance and marine equipment, and other services.

NEW Littelfuse Fuse Clip Bulletin Gives All Data

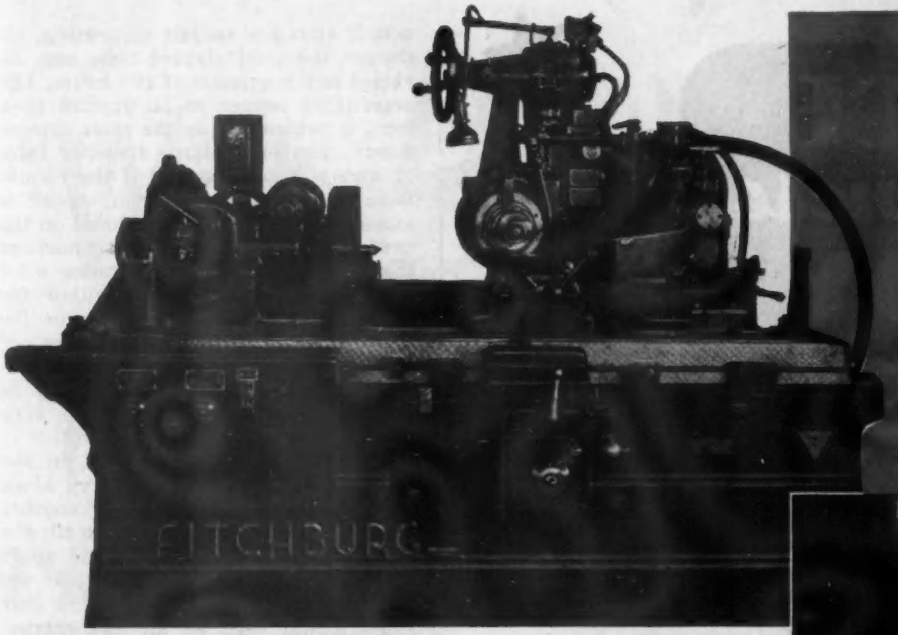
See what exclusive Littelfuse improvements have wrought in design and forming, for better contact, with the certain results of maximum electrical conduction—lower coefficient of heat, with protection of panel boards and switches. Littelfuse Clips provide contact over the largest possible area, with firm dependable grip.

Wherever clips are used, Littelfuse can help in *your* circuit protection.

LF LITTELFUSE INCORPORATED

200 Ong Street, El Monte, California

4757 Ravenswood Avenue, Chicago 40, Illinois



SPLINE GRINDING?
SPLINE SHAPING?
INTERNAL GEAR GRINDING?
EXTERNAL GEAR GRINDING?

.... Do all four on the Fitchburg Gear Grinder

Spline Shaper Attachment

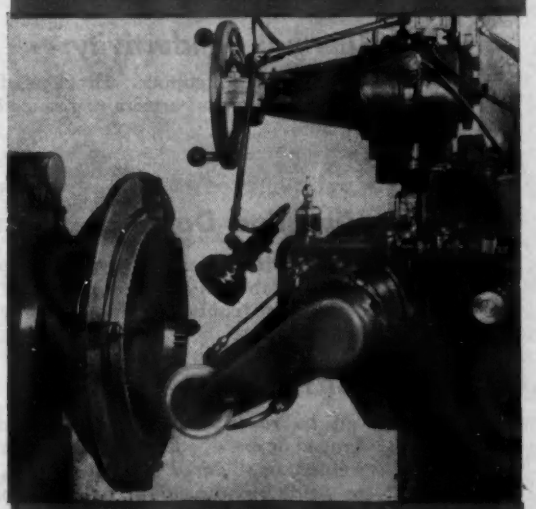
A single Fitchburg Gear Grinder, with special attachments will

GRIND internal or external, helical or spur gears — straight, taper and helical splines, and will also

SHAPE straight, taper and helical splines.

A leading automobile manufacturing plant now engaged in making airplane engines, is using Fitchburg Gear Grinders with Special Wheelheads in the important operation of grinding internal gears. They give highest praise to its accuracy, fine finish and high production at low cost.

You can get the same results on a variety of work—on this one machine—why not let Fitchburg engineers show you how. Write today.



Internal Gear Grinding Attachment

FITCHBURG GRINDING MACHINE CORP.

FITCHBURG, MASSACHUSETTS, U. S. A.

Manufacturers of—Bowgage Wheelhead Units, Multiple Precision Grinding Units, Spline Grinders, Cylindrical Grinders, Gear Grinders, Bath Full Universal Grinders and Special Purpose Grinders.

CHACE Manganese ALLOY No. 772 Offers You:

HIGH *Electrical Resistivity:—*

1050 ohms per circular mil foot, or about 60% higher resistivity than most commercial alloys. Ideally suited for low temperature resistor applications, rheostats, circuit breakers, and other electrically heated elements.

HIGH *Temperature Coefficient of Expansion:—*

twice as great as that of ordinary steel, considerably higher than aluminum.

LOW *Thermal Conductivity:—*

only 2% that of copper. Brackets of this alloy are being used as barriers to reduce heat losses by 50%.

HIGH *Vibration Damping Constant:—*

about 25 times greater than that of steel. Especially desirable in applications which cannot incorporate rubber or plastics to reduce vibration.

WORKABILITY:—

can be readily machined, stamped, drawn, flanged or extruded. Can be spot welded, butt welded, or soldered to itself or steel, or it can be welded by the atomic hydrogen process.

NOW AVAILABLE IN:—

sheets, strips, rods, and special shapes.

Complete engineering and research facilities available. Send for "Bulletin No. A-942" which gives detailed information regarding Chace Manganese Alloy No. 772.

W. M. CHACE CO.
Manufacturers of
Thermostatic Bimetals and Special Alloys
1610 BEARD AVE • DETROIT 9, MICH.

details that are subject to brazing, although the total elapsed time may be varied to a maximum of two hours. The amount of copper to be applied to a joint is determined in the same experimental manner. A large diameter helix of wire is tried first and if the results indicate that the amount of copper is excessive, the amount is reduced on the next try. It might be well to mention that no harm is done by running a lot through the furnace again either for addition of more brazing alloy or for improvement of the appearance of parts that have become oxidized. Consequently, since the operation may be repeated for salvage there are very few rejects from copper brazing.

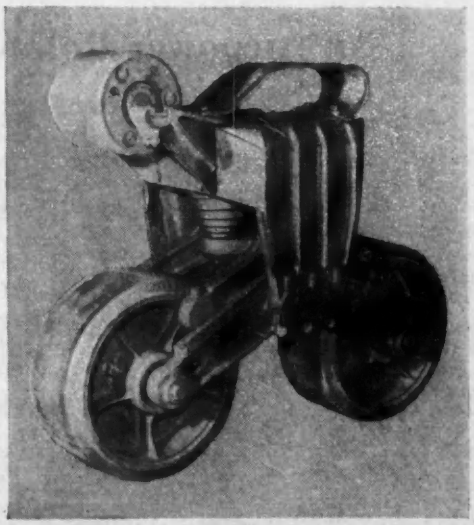
It has been discovered that in the brazing of dies, where a heavy block of metal is placed on top of another mass of material, it is better to tilt the assembly at an angle and to apply the copper on three sides only. If the copper is permitted to flow from four sides, it may form an air lock entrapping air in the joint, resulting in a poor braze. Ordinarily with telescopic joints that are not easily visible from both ends, the copper is introduced on the inside surface and permitted to flow to the outside, as indicated in Fig. 6. The appearance of copper in the other end of the joint is evidence of a satisfactory braze. In other words, copper rings should not be placed on both the inside and outside of a telescopic joint, because of the danger of entrapping air.

Brazing Proposals

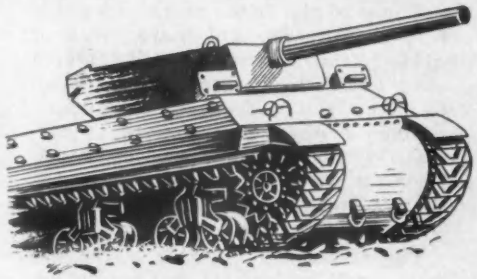
In order to sell brazing to the Engineering and Production Departments, Manufacturing Research has instigated brazing proposals. A proposal, complete with essential information, is submitted along with a photograph comparing the old method of assembly with the new method. In order to justify brazing, as a substitute for other methods of fabrication, a time study report on the part, indicative of the labor saving, is included. The weight saving indicated on the proposal indicates only the weight by the old method compared with the present method. It does not show a saving of raw material lost on the previous machining. Along with the proposal is submitted a sample part for structural tests. The thought behind all this procedure is to avoid duplication of effort. Various departments concerned are given a copy of the proposal.

Usually structural tests are performed on the part if it is primary structure. In addition, the X-ray inspection requirement of all primary structures is noted on the drawing release. A question often asked by the Engineering department is "What is the fatigue value of a copper brazed joint?" Usually, fatigue is one of those elusive factors that is very difficult to pin down. If engineers are given a value, it does not necessarily follow that they could apply it to the design in question.

"War Legs of a Giant"



Modern TANK SUSPENSION UNITS



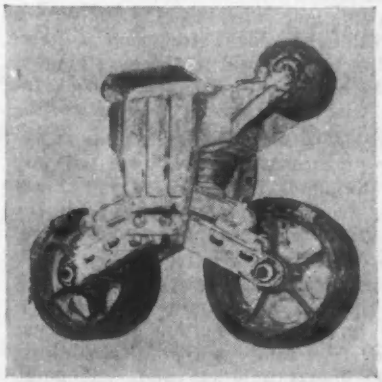
TANK DESTROYER

Built by F. L. Jacobs Co.

SUSPENSION PLANT

In keeping with the swift pace of modern warfare our production methods have been made flexible to meet the changing needs that result from battle experience. More than 140,000 of these tank suspension units as shown above, incorporating engineering improvements of startling importance have been produced at the F. L. Jacobs Co. Suspension Plant, Lonyo Blvd., Dearborn, Michigan. This successful unit is used on tanks, tank destroyers and recovery vehicles which are fighting for a decision this year with the great armies of invasion.

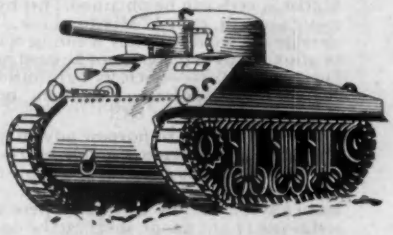
Vast Reclamation Program Sends Crippled Units Back to Fighting Fronts



This battle scarred unit when rebuilt will be as good as new equipment and fit to hold its own in our great mechanized army which is winning new victories every day.

Tanks and Tank Destroyers must take as well as give. Smashing the enemy on every front, these metal giants often receive crippling blows which send them home for badly needed repairs.

Here at F. L. Jacobs Co. Suspension Plant worker-fighters with long-acquired skills tear down and rebuild damaged suspension units. Parts are repaired and salvaged when possible—replaced if necessary. More than 14,000 of these damaged and battle-scarred suspension units have been rebuilt to meet Fifth Echelon Standards. This achievement in speedily restoring so much vital equipment to combat service is another important contribution to early Victory made by the F. L. Jacobs Co.



MEDIUM TANK

F. L. JACOBS CO.

Main Plant, 1043 Spruce Street, Detroit 1, Michigan

DIVISIONS

Grand Rapids Metalcraft Division
Grand Rapids, Michigan

Suspension Plant—Lonyo Blvd.
Dearborn, Michigan

Dallas Plant
Detroit, Michigan

SUBSIDIARIES

Air-Track Manufacturing Corp.
College Park, Maryland

Parts Manufacturing Co.
Traverse City, Michigan

Continental Die Casting Corp.
Detroit, Michigan

An Airpower Policy for America

(*Continued from page* 21)

Today American aviation—in operation, engineering, design and production — stands pre-eminent. Continued supremacy in the air will bring progress, prosperity, and security in peace after it has helped win victory in war.

It will be the cheapest possible insurance against recurring wars, with their horrible loss of life, tremendous costs and ultimate lowering of living standards.

Pursuing further the comparison of sea and Air Power, the former consists of five basic elements: the Navy, the Merchant Marine, the shipbuilding industry, strategic bases and a national seafaring tradition. Air Power is composed of comparable elements, including: Army and Navy air forces, commercial air transport, and private air transportation, the aircraft manufacturing industry, strategic air bases, and an air-minded public.

While sea power has a long established history of building and protecting nations, the corresponding effects of Air Power are only now being brought to light. If Air Power continues to be used properly in our behalf, there can be no doubt of the ultimate results.

Proficiency attained in any given field, whether by nations, communities or commercial organizations, is held by an unbroken continuity in its utilization. A break in the chain can lose the heritage. The aircraft industry offers invaluable assets in its management, technological and manufacturing personnel and facilities. But unless positive measures are taken to retain a strong nucleus of these national assets, the American aircraft manufacturing industry could be rendered ineffective in its future ability to serve the American people.

There is one fundamental difference between aircraft and many lines of industry that have temporarily entered some phase of war production. Whereas many plants designed for making civilian goods have converted to aircraft components—and can reconvert, when the war ends, to their normal activities—aircraft manufacturers are not in this fortunate position.

The automobile industry, as an example, will go back to the production of motor cars with a huge pent-up demand waiting. On the other hand, if the need for continuing Air Power is ignored, aircraft manufacturing companies will face a diminishing demand. The American people and the aircraft industry have a long-range partnership in planning the future of domestic and international air transport. There is a historic and, to the public, a profitable precedent for such a partnership to be found in the development of railroad and automobile transportation, with their great benefits to the nation and to individuals.

An investment in Air Power will pay rich dividends in future security, economic progress, employment, and in the broad advance of our civilization. These benefits will come not only through relative military security but also through the elimination of frontiers and the promotion of international friendship and understanding. Future peacetime aviation will make the world smaller and people separated by thousands of miles, and differences in languages and customs, close neighbors.

Maintenance of Air Power is the master need as we move the Aircraft industry from war to peace. Technological development through competitive industry is the key to air power. In light of the proven decisive character of Air Power, we recommend new legislation restating as national policy the principle of advancing technological development of aviation through competitive private industry.

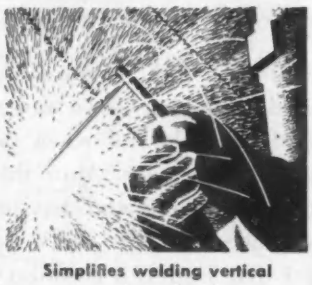
Revolutionary Hy-cycle Automatic Arc Provides Complete Control of Arc and Heat

At last, a development that automatically starts the arc before the welding electrode actually comes in contact with the work! Eliminating the "pecking" or "scratching" that so often creates tension and operator fatigue. Its many advantages contribute largely to saving time and labor because an operator can be trained in far less time than usual, and higher speeds can be obtained. This hy-cycle automatic arc unit, called "Missing Link," permits the operator to weld with any welding rod, bare steel or alloy. Rods that could not be used before can be burned with ease—such as bare mild steel, dust coated, reverse polarity, aluminum, bronze, stainless steel, etc., AC or DC.

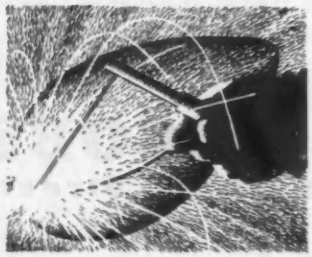
One of its most important advantages is welding light gauge. Light gauge requires low heat—making many jobs almost impossible for ordinary methods. Since the "Missing Link" starts automatically on as low as one ampere of heat, the welding of light gauge sheet can be done with surprising speed with no time out for "pecking" and "sticking."

You all know that our fighting men need the finest quality materials that we here at home can produce. That goes for Wrigley's Spearmint Gum, too. Although our stock pile of quality raw materials is getting lower and lower we are maintaining our standards of quality. Naturally, we are forced to limit production. So we are giving priority where it is needed most—and where you want us to—our fighting men and women overseas only. Because chewing gum is essential to them—they are getting all of our limited production of Wrigley's Spearmint Gum.

You can get complete information from Mid-States Equipment Company, 2429 S. Michigan Ave., Chicago 16, Ill.



Simplifies welding vertical and overhead



Makes it easy to weld light gauge work

Y-133

. . . ANSWERS THE DEMAND FOR MILLING MACHINES DESIGNED IN TERMS OF CORRECT MOTOR POWER

More than ever before, motor hp. is the number one factor — the starting point when purchasing milling equipment. Range is important, of course, particularly with milling machines for light cuts, but motor hp. of ample rating is the first consideration wherever heavy cuts are involved.

Since motor hp. is of such basic importance the substitution of a higher hp. motor above that of the motor normally specified for a No. 2 Milling Machine — to gain power and speed — is unsound practice because the power is excessive and out of balance with the design and construction of a No. 2 Machine.

Milwaukee Milling Machines are power-engineered — *PoweRated* — designed and built in keeping with their hp. range plus the normal overloads encountered within their field of job application. You can always be sure of the correct motor power in every Milwaukee.

The next time you need milling equipment, think in terms of motor hp. for heavy cuts — range for light cuts — and check with a Kearney & Trecker field engineer in deciding which *PoweRated* Milwaukee is best suited to your specific needs.

PoweRated — Means Every Milwaukee Is Power — Engineered To Do The Job

- **MILWAUKEE PoweRated MILLING MACHINES**
- **Standard Models—Horizontal, Vertical and Bed Types — available in Motor ranges from 3 to 25 HP.**
- **C.S.M. (Carbide Steel Milling) machines 20 to 50 HP.**
- **Special Machines — Consult K&T engineers.**

BACK THE ATTACK . . . BUY MORE BONDS

Milwaukee Machine Tools

KEARNEY & TRECKER CORPORATION

MILWAUKEE 14 WISCONSIN

German Aerial Torpedo

(*Continued from page* 31)

The height and range controls are accessible from the outside of the fuselage a removable panel on the port side being provided for this purpose.

Supported at the front by the strut just mentioned and at the rear on the top of the fin, the propulsion unit, of welded steel, is about 11 ft in length and is entirely exterior to the fuselage. It is described as a "true jet propulsion" unit, the first to be put into operational service. At the front end is a large air intake in which is a multiple flap valve resembling a series of unbalanced shutters. Behind the valve are fuel sprayers and behind these a venturi with a central ignition plug.

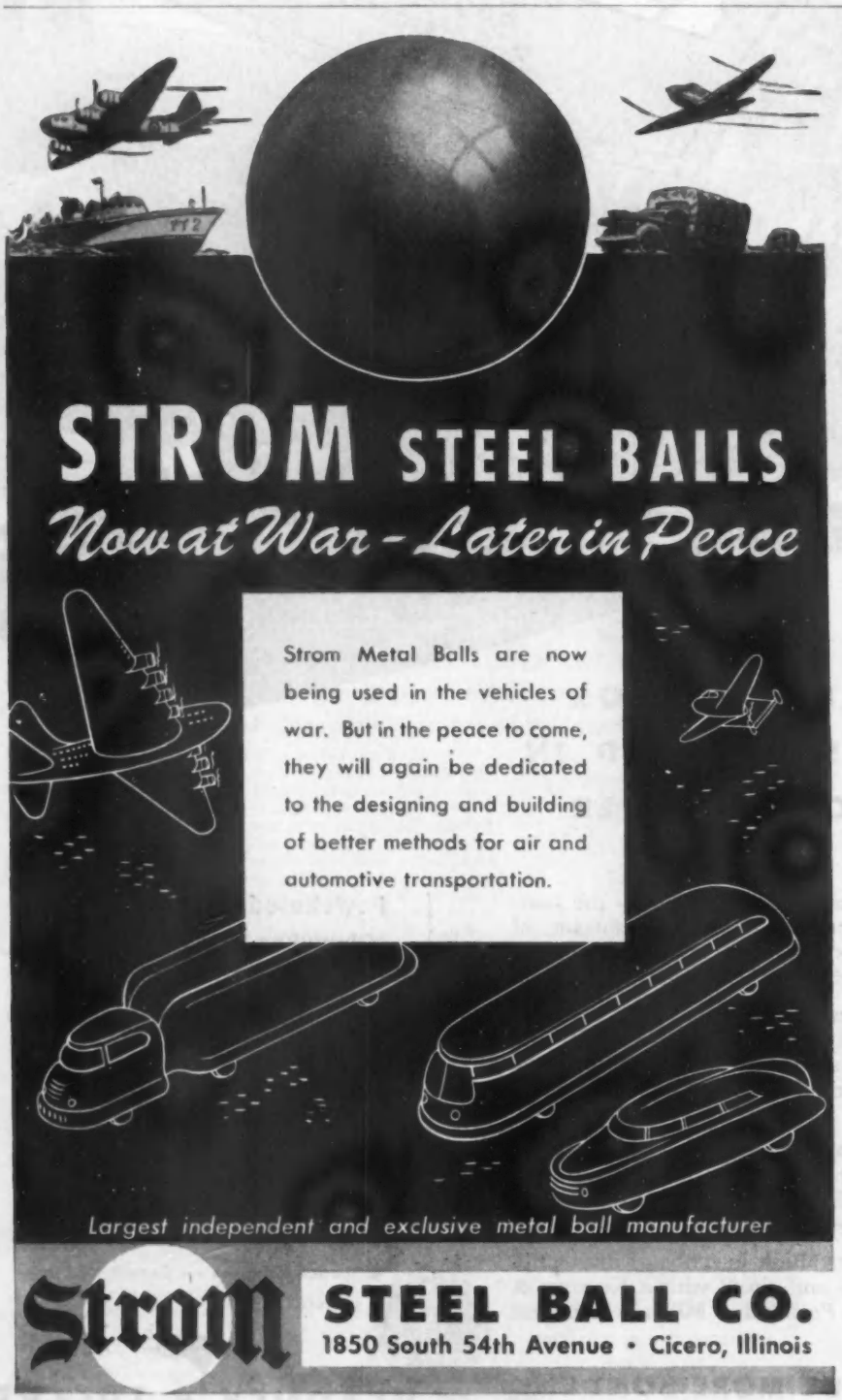
The fuel is fed under air pressure to the sprayers. The rate of fuel delivery, therefore, is to some extent dependent upon the pressure in the air bottles, and this, it is suggested, probably provides a clue to the widely differing reports as to speed. In the early stages of its flight the missile undoubtedly travels at 300-350 mph; but towards the end of its flight a speed of 200-250 mph appears to be more usual.

It is not clear yet whether the compressed air is used merely to deliver fuel under pressure, or whether it also is mixed with the fuel to atomise it upon injection. Combustion of the mixture after ignition by the single spark plug is intermitten and is believed to give rise to the characteristic pulsating noise of the exhaust, which, strange from a jet propulsion unit, led originally to the belief that a more or less conventional internal combustion engine was used.

According to reports, operation of the power unit is as follows: Owing to the forward speed of the machine, air is rammed into the propulsion duct, and into the slightly compressed air the fuel is injected and ignition occurs. Whether injection is continuous and ignition periodic, whether the igniter is a continuous glow plug and injection periodic, or whether, again, both injection and ignition are periodic is not yet clear. But it is evident that in a relatively confined space there is combustion giving a sharp rise in pressure which closes the air intake valve, resulting in the products of combustion being violently ejected from the rearwardly directed propulsion nozzle. As the internal pressure falls, the flap valve is opened again by the pressure of the air stream, a new charge of air is rammed into the unit and the cycle is repeated.

The lack of a compressor, intermittent instead of continuous combustion, the use of an automatic flap valve and the system of fuel injection indicate low efficiency; but doubtless this is a minor consideration. To save weight, material and production time in both manufacture and assembly would probably be considered much more important than high thermal efficiency in a so-called military weapon of this kind.

Duration of flight is determined by a time switch that, probably, trips the automatic pilot and puts the machine into a steep dive (about 60 deg. as a rule), though loss of pressure in the air bottles or depletion of the fuel tank, not to mention derangement by gunfire, will obviously terminate the flight. The varying descriptions of final behavior—power dive, powerless glide, sharp cut-off and gradual fade-out of the propulsion unit—would be accounted for by these factors. Stalling speed seems to be high, doubtless as a result of the high wing loading. In the air stability does not appear to be good and at least one has been seen to do an uncontrolled roll and others to put down one wing and go into a spin.


STROM STEEL BALLS
Now at War - Later in Peace
Strom Metal Balls are now being used in the vehicles of war. But in the peace to come, they will again be dedicated to the designing and building of better methods for air and automotive transportation.
Largest independent and exclusive metal ball manufacturer
Strom STEEL BALL CO.
1850 South 54th Avenue • Cicero, Illinois

ON LIGHTER, STRONGER TIRES

Official U. S. Navy Photo

UNITED STATES RUBBER COMPANY

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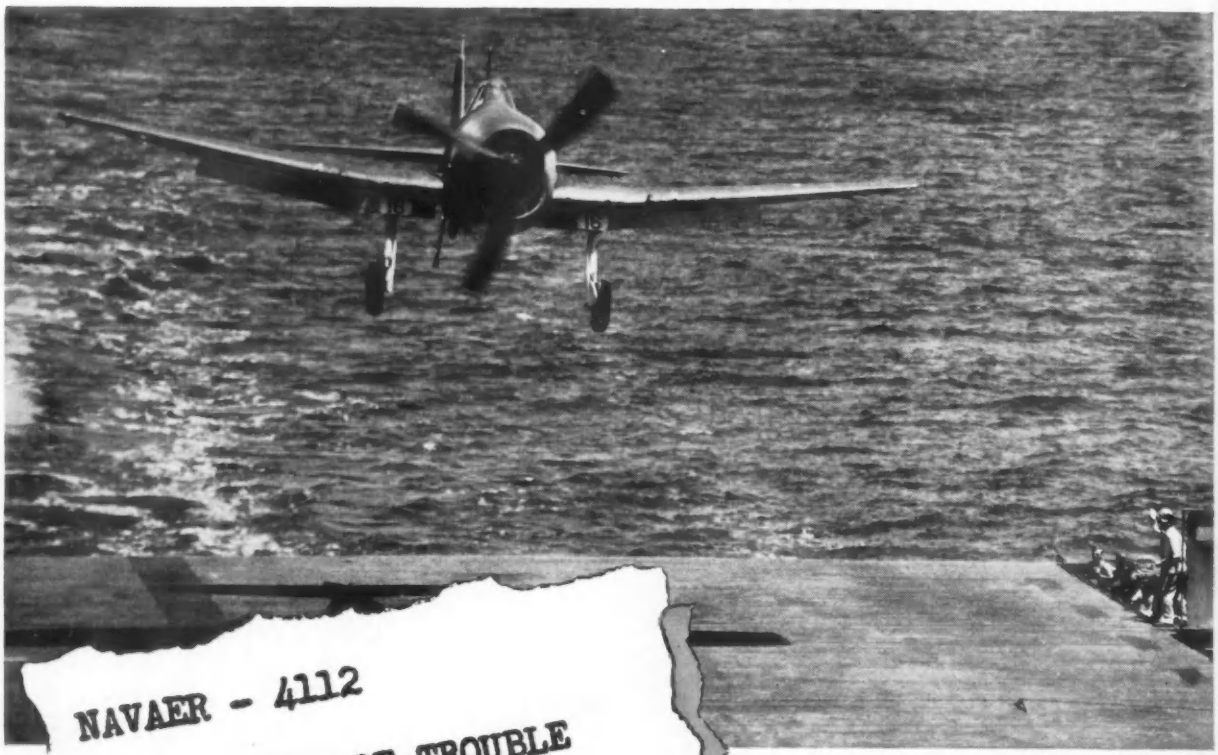
HOW THE NAVY HELPS BUILD

Reporting the Problem



Official U. S. Navy Photo

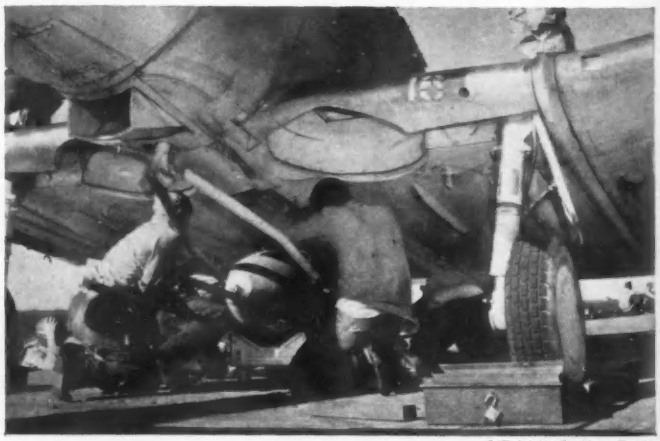
A Navy Grumman Hellcat fighter comes in for a landing on a first line aircraft carrier operating in a Pacific Fleet task force.

NAVAER - 4112

STATEMENT OF TROUBLE

...Tires are blowing out under impact of deck landing, causing sev-

Even with the most exacting care in specifications and manufacture of airplane tires and tubes, combat conditions often develop weaknesses that must be corrected; improvements that should be made to give our fliers greater effectiveness and greater safety. Through reports from combat zones called R.U.D.M. (NAVAER-4112) the Navy Bureau of Aeronautics at Washington is kept constantly in touch with all problems. When these reports are received, they are immediately relayed to all interested suppliers for quick action.



Official U. S. Navy Photo

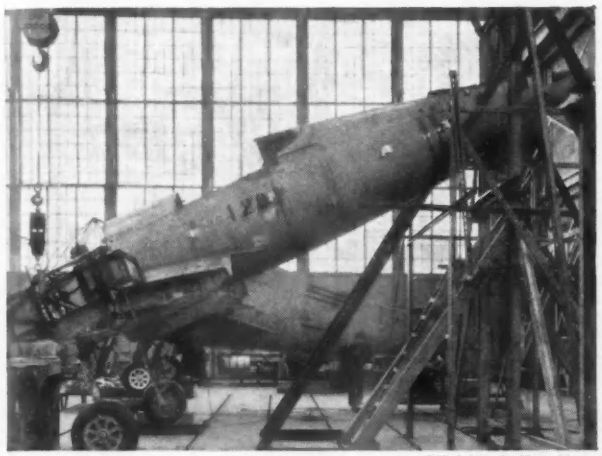
A THOUSAND-POUND BOMB is loaded on a Navy Douglas Dauntless dive bomber about to take off. This added fighting power is another reason why the Navy's tires must be strong to carry the load and light to keep down weight.

1230 SIXTH AVENUE **UNITED STATES**

LIGHTER, STRONGER, SAFER TIRES

Finding the Answer

Not only does the Navy send its various suppliers performance reports direct from combat areas but it also constantly conducts its own laboratory and service tests. All findings that will assist manufacturers in improving their products are sent on to them for study. In this way, the technical staffs of industry benefit from the Navy's testing program just as industry's research serves the Navy.



Official U. S. Navy Photo

DROP TEST—At one of the test laboratories of the Navy Bureau of Aeronautics, landing wheels are "drop tested" on a rig like this. Here a set of landing wheel tires is mounted on the rig and dropped under full load simulating landing impact.

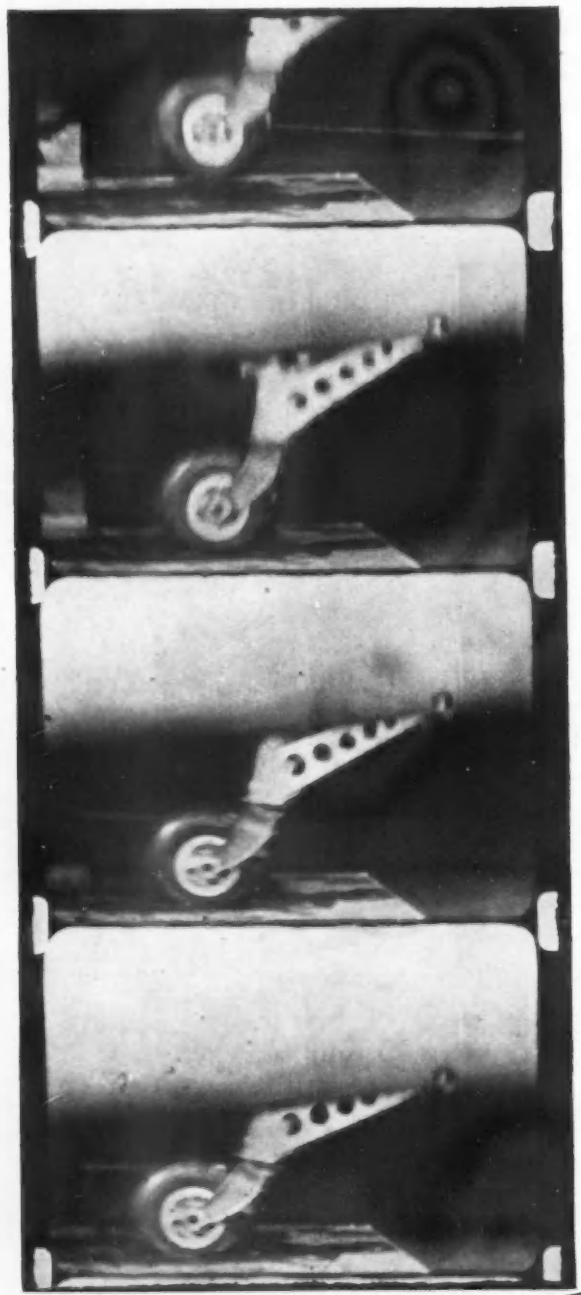
Official U. S. Navy Photo

DECK TEST—Actual service tests carefully supervised by Navy engineers show how the product stands up in service. On tests like this, U. S. Royal Airplane Tires—and tires of all other suppliers—must prove their ability to "take it."

Official U. S. Navy Photo

BATTLE TEST—The toughest test of all is the battle test where all rules are off—where the most extreme condition may be met, where loads are heavy and speeds are high. All the testing, all the checking, all the reporting of problems wherever they occur are parts of the Navy's precept and practice—"never waste a life."

RUBBER COMPANY ROCKEFELLER CENTER • NEW YORK 20, N. Y.



Official U. S. Navy Photo (Unretouched)

Slow motion picture

OF A NAVY FIGHTER SITTING DOWN!

This is an unretouched motion picture taken in the Navy's own testing laboratory showing what happens when the tail assembly of a Navy fighter "sits down" on a carrier deck. (Carrier landings are tail first, of course.) Under full load, the tail wheel tire strikes the landing strip and squashes almost flat under the impact. Tests like this show why tail wheel tires must be built with extra strength, extra stamina to stand the bruising "sock" of carrier deck landings.

The tests described in these pages are examples of the vision of the leaders of all our Armed Forces in providing our fighting men with the most effective fighting equipment that modern science can devise.

U.S. Royal Airplane Tires for landing wheels, tail and nose wheels, and for beaching gear are available in all standard sizes in smooth contour and high pressure types. For complete data book including full page deflection charts write on your business letterhead to United States Rubber Company at address below.

SERVING THROUGH SCIENCE TO SPEED THE VICTORY

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK 20, NEW YORK

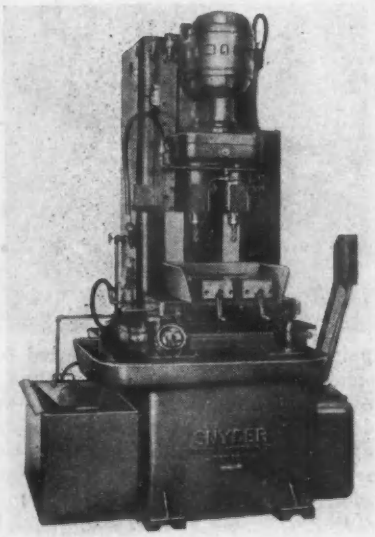
New Production Equipment

(*Continued from page 37*)

mens testing as follows: tensile strength, 62,000 to 70,000 psi; yield strength, 52,000 to 57,000 psi; ductility (elongation in 2 inches), 23 to 30%.

"Fleetweld 35" conforms to American Welding Society specifications for arc welding electrodes classes E-6010 and E-6011. It is made in the standard 14-in. lengths and is packed in 50-lb containers.

A SPECIAL-PURPOSE milling machine, developed by Snyder Tool & Engineering Company, Detroit, Mich., is used in milling a rectangular pocket inside the dome of an aircraft piston and removing stock from the inside faces of the wrist pin bosses. The machine is an adaptation of a Snyder standard piston milling machine and includes the standard base, column, hydraulic unit and coolant tank assembly.



Snyder special-purpose milling machine

The 2-spindle milling head has fixed center distance requiring cutters of identical diameter. Each spindle is mounted in a quill providing lengthwise adjustment for tool life.

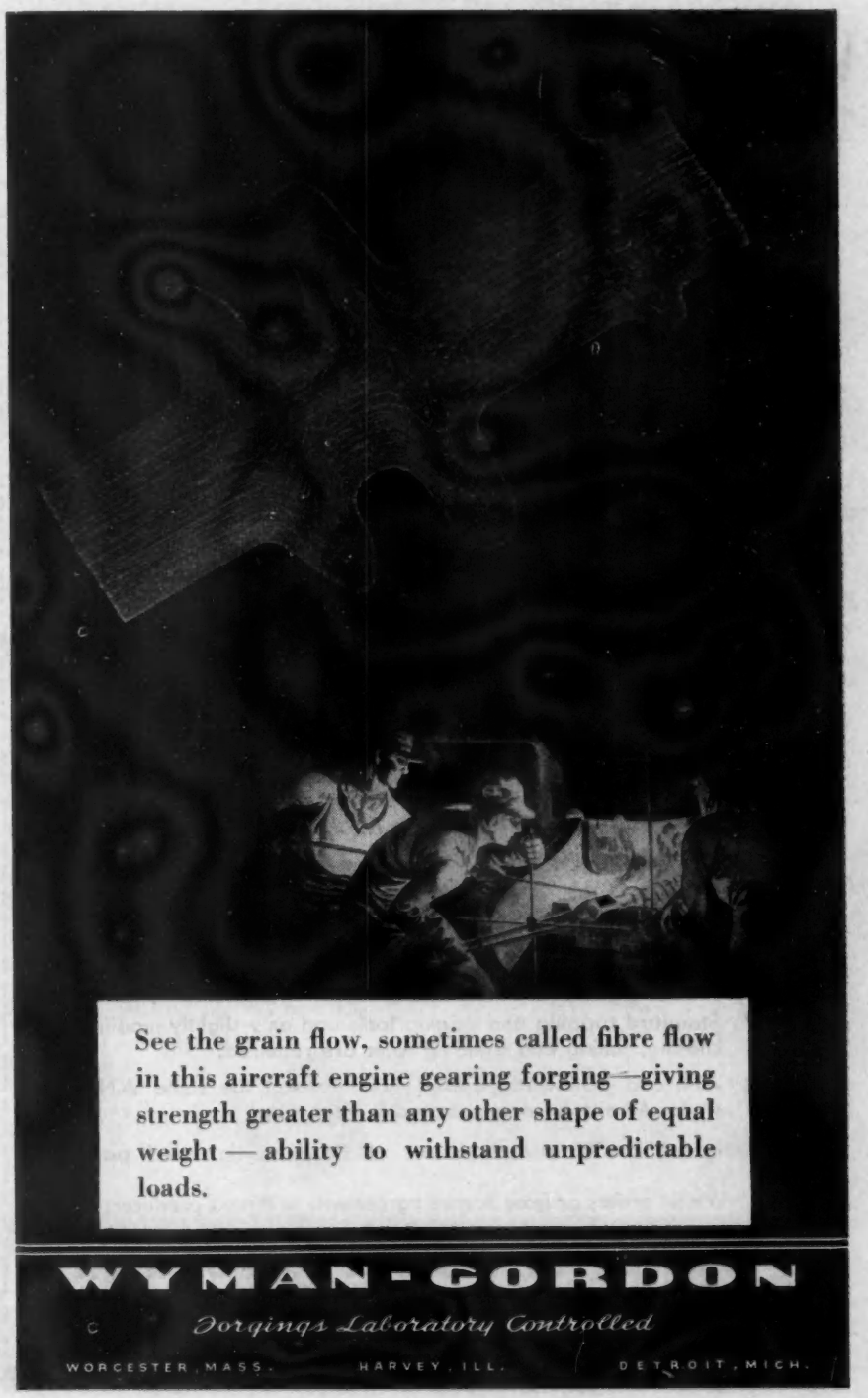
The machine takes two parts, performing identical operations on both. The piston is located radially by means of a plug entering the wrist pin hole and is clamped manually between vise jaws. After the cycle start button has been pressed, all operations are performed automatically, the cutter head retracts to the stop position, cutters cease running and parts are unloaded.

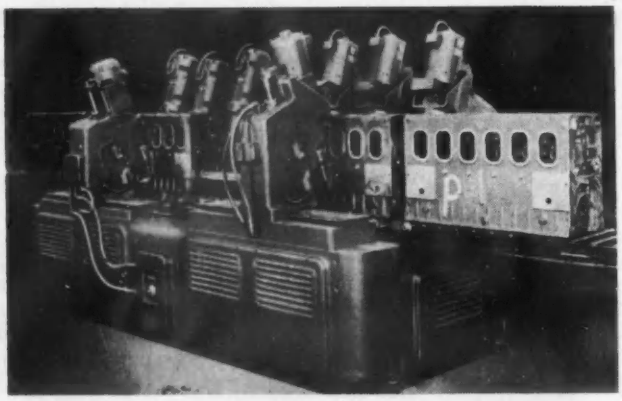
THE Yale self-dumping hopper has been designed by the Yale & Towne Mfg. Co., Philadelphia, Pa., for handling quantities of small parts, loose materials and scrap. This Yale development is an all-metal skid bin with a hinged bottom. It can be picked up and moved by hand-lift truck, but the dumping operation can be accomplished only when the hopper is employed in conjunction with an electric fork truck.

Dumping is done by elevating the hopper by means of the truck forks until the bin handle engages with a positive-action catch at the top of the truck elevating column. The forks are then lowered, leaving the hopper suspended. The unsupported hinged bottom opens, allowing the contents to pour forth wherever desired.

The empty hopper is released from the catch on the elevating column by raising the forks. The feed hopper is then lowered on the forks and carried away for refilling.

THE Cross Company, Detroit, Michigan, has designed and built a completely automatic transfer-type processing machine for cylinder blocks. An important feature of this machine is that the work is automatically picked up from the conveyor, completely processed, ejected from the machine, and


See the grain flow, sometimes called fibre flow in this aircraft engine gearing forging—giving strength greater than any other shape of equal weight — ability to withstand unpredictable loads.
WYMAN-GORDON
Forgings Laboratory Controlled
WORCESTER, MASS.
HARVEY, ILL.
DETROIT, MICH.



Cross transfer-type processing machine for cylinder blocks

redelivered to the conveyor without being touched by human hands. Production is given as 45 pieces per hour at 80 per cent efficiency.

Although the machine illustrated consists of only two stations—a drilling and a tapping station—the builders state that the same principle is being used in other machines requiring more stations for processing intricate work necessitating a multiplicity of operations. The entire process is continuous and automatic, without operator attention, after the machine is started.

FROM NOW ON STUD TROUBLES ARE UNNECESSARY!

From the first use of screw threads for stud fastenings pure shear has been the limit of holding ability.

Now the Dardelet thread, for normal loads, changes the shear to compression loading and cold works the metal at assembly, with the following obvious advantages:

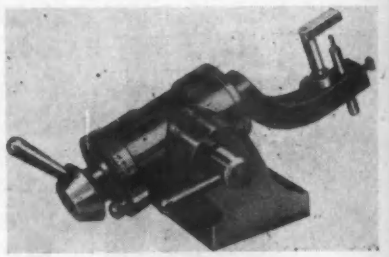
1. Added strength.
2. Fatigue life materially lengthened.
3. Root interference eliminates lateral motion; studs remain tight.
4. We have had no galling at random assembly of several hundred studs per case.
5. Service simplified with salvage of precious parts vastly improved.
6. Can be fluid tight by selection of the tap reamer size.
7. Standard tapping and gaging tools and only slightly modified chasing, rolling and grinding tools are required.
8. A.N. and Whitworth tapped holes accept the same A.N.D. stud. All can be demonstrated in your shop.

ARMED SERVICES use thousands of Dardelet threaded parts.

We fill orders or issue license agreements to thread producers

DARDELET THREADLOCK CORPORATION
2832 E. Grand Boulevard, Detroit 11, Mich.

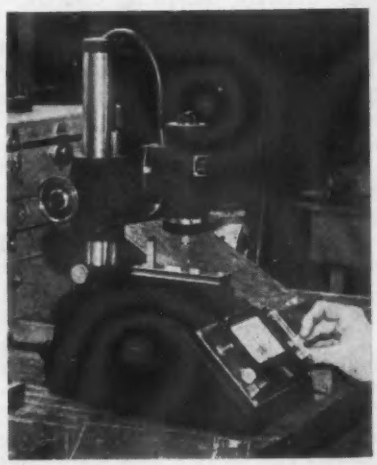
LATEST addition to the line of The U. S. Tool & Mfg. Co., Dearborn, Mich., is a precision angle-correcting radius dresser, No. T-124, that not only does the work of a radius dresser but is designed to also dress the corrected radius on wheels for grinding compound and compound-complex forms. This tool, which employs the direct reading principle, is fitted with Timken tapered roller bearings and a one-piece hardened steel spindle arm. All exposed



No. T-124 radius dresser

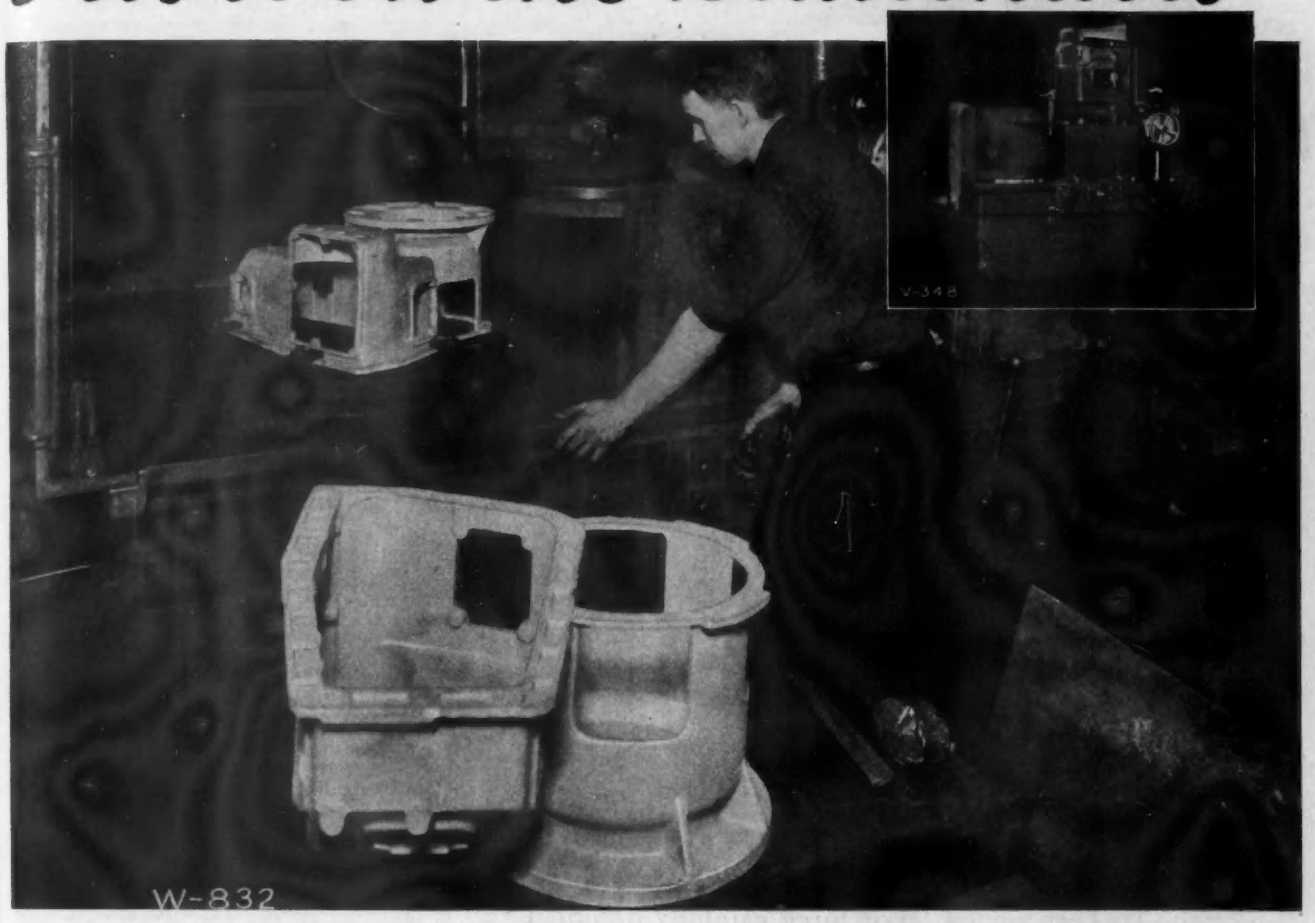
unpainted parts are chrome plated for protection against rust or stain, and a hardened tool steel wear plate on the under side of the base prevents chipping of the cast iron body. Both scales are easy to read and are readily accessible.

A COMPLETE line of DoALL comparators is now being manufactured by Continental Machines, Inc., Minneapolis, Minn. Spindle pressure is adjusted by



DoALL comparator

"Put it on the Blanchard"



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Production ✓
Adaptability ✓
Fixture Saving ✓
Operation Saving
Material Saving
Fine Finish
Flatness ✓
Close Limits

Grinding Aluminum Base Castings

These frail castings are ground on two sides flat and parallel on a No. 18 Blanchard Surface Grinder. They measure 23½" x 21½" x 11" and 5/32" stock is removed from each side. One piece is ground at a time, lightly held by clamps to a steel base plate which is magnetically held on the chuck. Two pieces, four surfaces, are finished per hour.

If you have work, large or small, that requires flatness, squareness, parallelism and fine finish, "put it on the Blanchard" for best and fastest results.

Send for your free copy of "Work Done on the Blanchard." This book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

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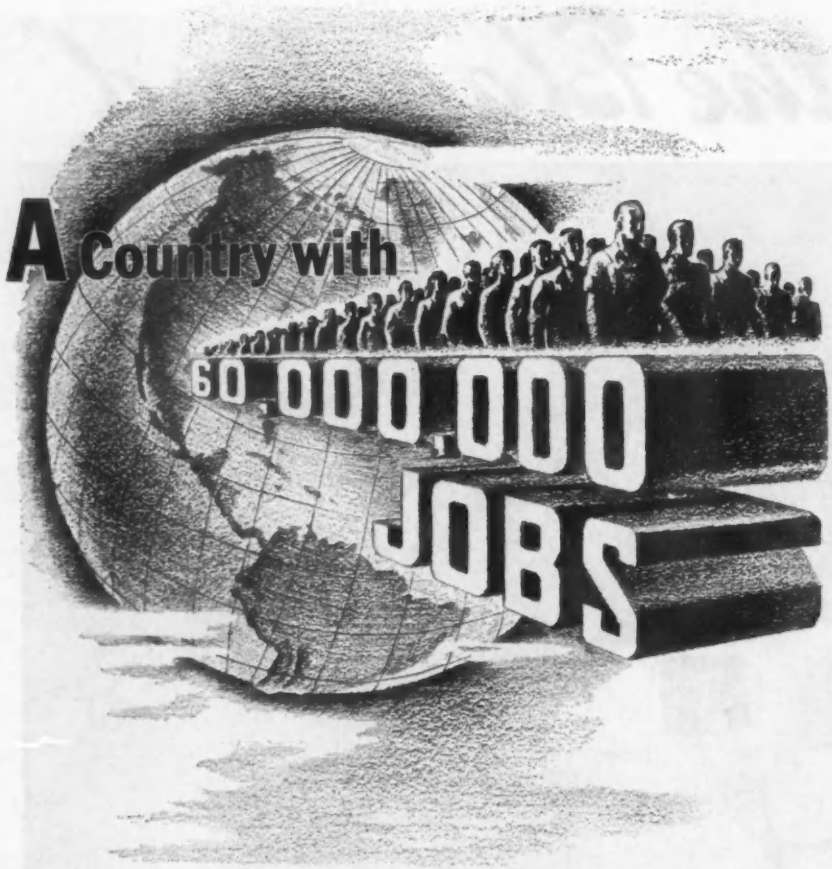
The BLANCHARD MACHINE COMPANY
64 STATE STREET, CAMBRIDGE 39, MASS., U. S. A.



IT'S hard to realize that the United States of tomorrow will include about 60,000,000 working men and women. To keep such a labor force gainfully occupied means high-speed, low-cost production to hold prices down and volume up.

In this better, bigger, busier world of tomorrow you can profit by the experienced engineering advice that is one of the most important factors in Acme service. We design and make special tools to operate exclusively on your product and processes. We also manufacture dies, patterns, gages and fixtures. And, we produce to your specifications heat-treated aluminum castings that have no superior in their field.

Acme service to the metal-working industry is complete. Your inquiry will receive prompt attention.

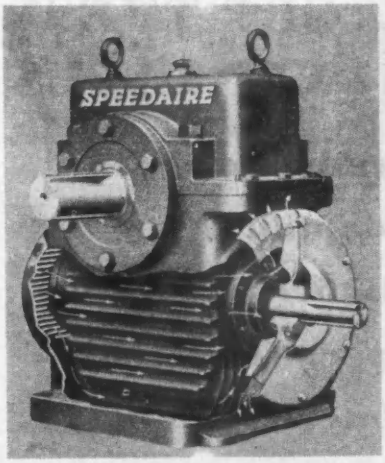
ACME *Pattern and Tool Company, Inc.*
DAYTON, OHIO

HEAT-TREATED ALUMINUM CASTINGS . . . PATTERNS . . . TOOLS
TOOL DESIGNING . . . PRODUCTION PROCESSING

a calibrated dial located at the top of the unit. The gage head may be removed from the stand and used on a surface plate, machine tool, multiple gaging fixture, or for any other special application. The differential electrical circuit used in the comparator minimizes expansion due to temperature changes and drifts due to line voltage fluctuations.

Three models of the comparators are offered, each having four ranges of magnification. The Model 10, having a magnification range of 100,000, 50,000, 10,000 and 5,00, will measure variations of from one millionth to four hundred millionth inches. The Model 20, having magnifications of 10,000, 5,000, 1,000 and 500, will measure variations from ten millionths to four thousandths inches. The Model 30, having magnifications of 2,000, 1,000, 200 and 100, will measure variations from fifty millionths to twenty thousandths. All DoALL comparators operate on 110 volt, 60 cycle, alternating current and are protected so that accidental plugging into a direct current outlet will not damage the comparator.

THE Speedaire worm gear reduction unit, offered by Cleveland Worm and Gear Company, Cleveland, Ohio, incorporates a fan cooling system which permits a reduction in size of the unit required for a given output. The basis of the cooling system is a new type of double wall construction which provides an air passage completely enveloping the oil reservoir in which the gear operates. The inner housing wall forming the oil reservoir is deeply finned

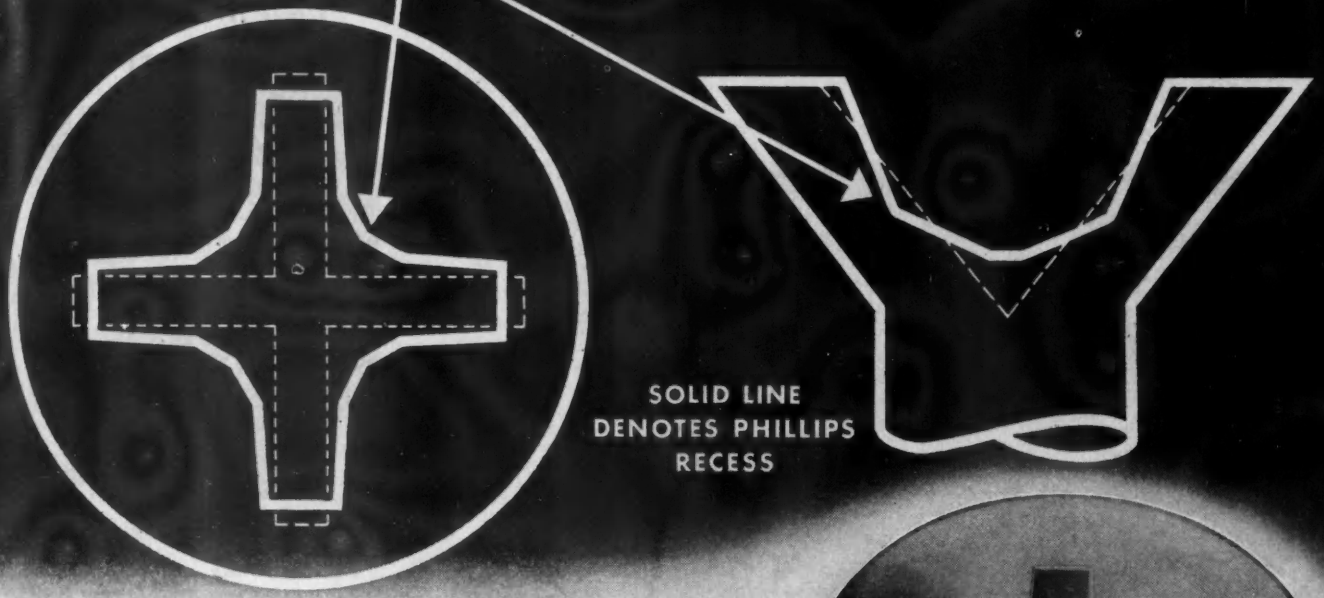


Speedaire worm gear reduction unit

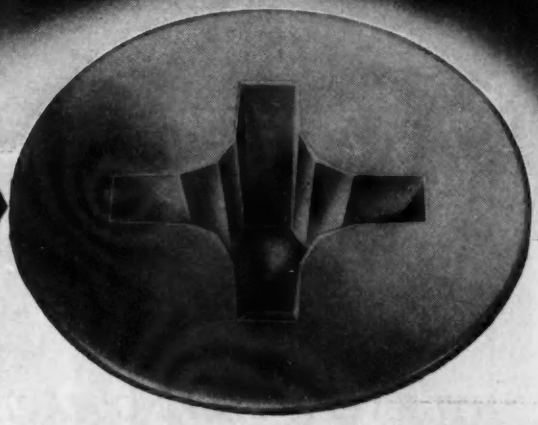
on the air side, resulting in a marked increase in heat-dissipating surface.

An exhaust fan located on the coupling end of the worm shaft draws air at high velocity through the space between the housing walls from a grill at the opposite end of the unit. This fan is designed to operate with either direction of rotation. The effect of the double wall construction is to maintain a uniform flow of cooling air against

ONLY ONE *Recessed Head Screw has these 2 Trouble-Saving Features...*



It's PHILLIPS.. *the Engineered Recess*



The left-hand drawing shows how scientifically the center corners of the Phillips Recess are *engineered.* Instead of being squared, these corners are *rounded* in a series of flat planes, with every angle and every dimension making a definite contribution to driving efficiency.

This makes it possible for workers to utilize full turning power – without danger of burring or reaming out the heads of Phillips Screws.

Now examine the right-hand drawing. This shows *more* scientific engineering. Instead of being tapered to a sharp point that would weaken the screw shank, the Phillips Recess has a nearly flat bottom.

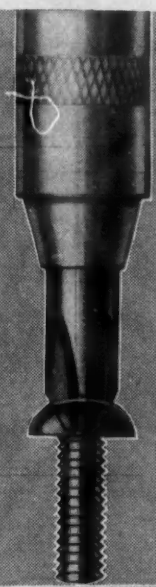
This makes it possible to set screws up uniformly tight without fear of screw heads shearing off. The flat bottom also permitted design of a stronger, longer-lasting driver point.

Only the *Phillips* Recess is engineered this way. Only when you specify screws with the Phillips Recessed Head can you get the freedom from trouble . . . the strength and driving speed these features make possible. You can get Phillips Recessed Head Screws in any head style, type, or size.

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS · MACHINE SCREWS · SELF TAPPING SCREWS · STOVE BOLTS

TO MAKE WARTIME QUOTAS AND PEACETIME PROFITS-- USE PHILLIPS SCREWS AND DRIVERS



Faster Starting: Driver point automatically centers in the Phillips Recess . . . fits snugly. Fumbling, wobbly starts, slant driving are eliminated. Work is made trouble-proof for inexperienced hands.

Faster Driving: Spiral and power driving are made practical. Driver won't slip from recess to spoil material or injure worker. (Average time saving is 50%.)

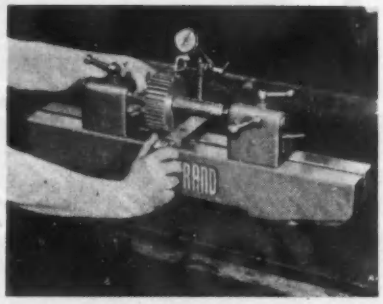
Easier Driving: Able to utilize their full turning power, workers can maintain speed without tiring.

23 SOURCES

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Wolverine Bolt Co., Detroit, Mich.

the fins and housing wall over the whole oil reservoir surface, and thus utilize the full heat transfer efficiency of the system.

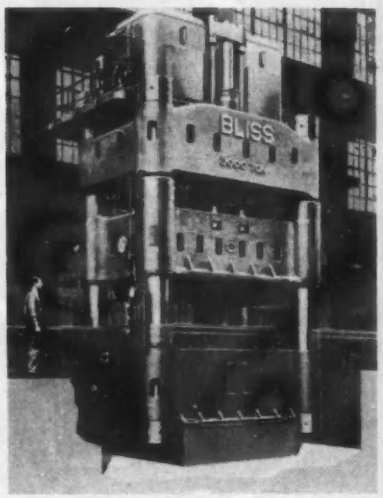
PRECISION checking of work between centers is said to be simplified and speeded up with the improved bench center brought out by the Sundstrand Machine Tool Company, Rockford, Ill. Unclamping, positioning and locking in place of both the heads are achieved with a single hand operating the top lever.



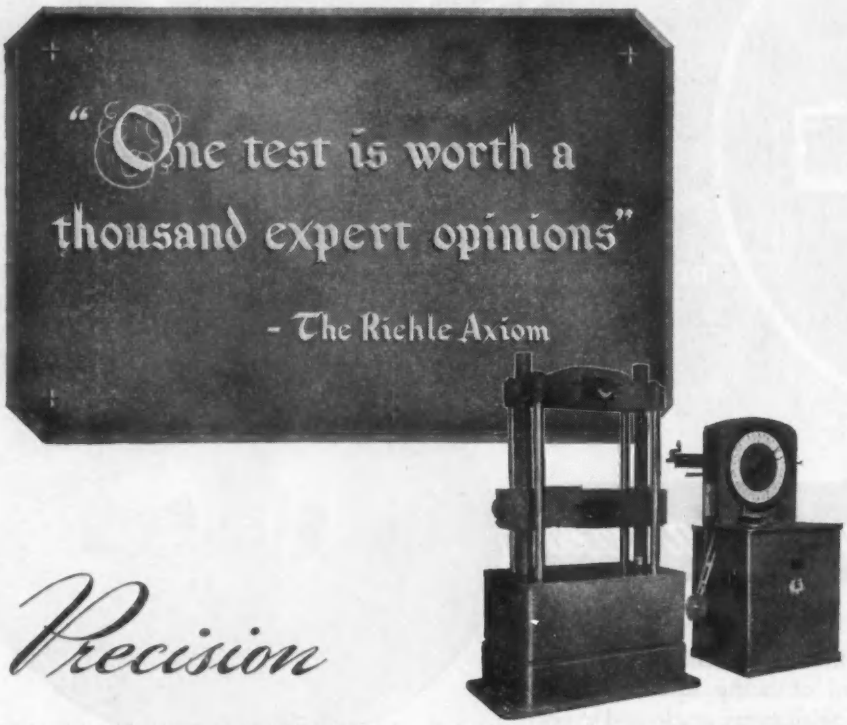
Sundstrand bench center

The center in the left head is fixed, but the center in the right head is spring loaded and can be retracted by the end bar for quick loading and unloading. The front clamp on the right head locks the center in position during checking operation. The indicator support is manipulated with one hand when moving it away from the work for loading and unloading, and against the work when checking for runout.

Large Hydraulic Press



This 5000-ton, two-die slide hydraulic press was built by the E. W. Bliss Company, Brooklyn, N. Y., for installation in a large U. S. bomber plant. It has an overall height of 30½ ft and is said to be one of the largest and heaviest self-contained presses ever built.



Precision

HYDRAULIC TESTING MACHINES

Pendulum load indication is more accurate and dependable because it operates on the natural laws of gravitation. This principle of operation is not affected by temperature changes or subject to metal fatigue. .

. . . . have repeatedly demonstrated the practical truth in the words, "One Test is Worth a Thousand Expert Opinions." Because they have simplified the science of testing the physical properties of materials they are widely used throughout the wartime industries today. Here Riehle Testing Machines "ferret out" material weaknesses and defects; avoid failures before they occur. This technique of progressive testing on the production line and in research laboratories saves valuable machine and man-hours. Write for descriptive literature and quotations.

RIEHLE *HYDRAULIC TESTING MACHINES*

Riehle Testing Machine Division, American Machine and Metals, Inc.

EAST MOLINE, ILLINOIS

Other Products: IMPACT TESTERS • VICKERS HARDNESS MACHINES
BRINELL HARDNESS TESTERS • MEASURING INSTRUMENTS

New Use for Plane Loader

A Clark plane loader being used for removing wounded soldiers from a transport plane to an ambulance for transportation to a base hospital. According to a recent report, more than 220,000 U. S. casualties have been evacuated by air from all parts of the world.

What will an Ex-Pilot expect of a

PEACETIME STEERING WHEEL?

Certainly no less than the qualities and serviceability of the finest Lumarith* Plastics for war planes.

Looking ahead to motor cars and planes of tomorrow? Give a thought to that one part handled most—the steering wheel. Plastics come to mind first of course—probably Lumarith, because this versatile Celanese plastic has been so thoroughly proven in war and peace.

ON THE ONE HAND

Dimensional and Surface Stability—Lumarith, injection molded over metal, is unusually tough even at temperature extremes; highly resistant to moisture, aging, warping. Elongation, so important, is more than adequate to handle differences in expansion coefficients between plastics and metal cores. The chip-proof surface actually is self-polishing. Colors are rich, stable.

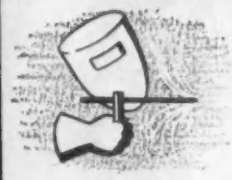
AND ON THE OTHER

Lightness and "Feel"—Formulations of Lumarith C.A., Lumarith X, and Lumarith E. C. are lightweight without sacrifice of flexural strength. Molded parts are inviting to the touch despite the weather.

Plastics will be bigger than ever in post-war automotive production. Let us help you plan projected improvements. We have accumulated data on a wide range of Lumarith formulations for all types and grades of automotive plastic applications from steering wheels to dash crystals. *Celanese Celluloid Corporation,* The First Name in Plastics, a Division of the Celanese Corporation of America, 180 Madison Avenue, New York 16.

*Reg. U. S. Pat. Off.

PAGE *Welding* ELECTRODES



PAGE COATING HELPS YOU ON YOUR STAINLESS WELDING

Certainly it is important to you that **PAGE** developed a range of electrodes for welding stainless steel that is complete.

But don't overlook the important value to you of the **PAGE** coating on these electrodes—sufficiently heavy to provide the shield necessary to prevent oxidation; to provide the protection of easily removed slag that permits more cooling time; that eliminates surface checking, and that holds spatter loss to a minimum.

PAGE ALLEGHENY STAINLESS STEEL ELECTRODES provide the metal you want, help you get it where you want it and protect the job your men do. Ask your local **PAGE** Distributor.

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Gairing four flute step-multiple Tungsten carbide tipped cutter used in the production of parts for a marine engine.

Gairing Tungsten carbide tipped multi-diameter cutter for boring, facing and chamfering operations on airplane engine cylinder heads.

Gairing profile-ground radius cutter combining multi-diameter boring flutes and core drill used in the production of a tractor engine.

Tools that translate ideas into realities

The end cutting tools illustrated here are the net result of creative ideas that first existed in the minds of engineers; ideas about a marine engine, an aircraft engine and a tractor engine. These ideas were passed on to us for translation—for the design and manufacture of the *special* Tungsten carbide tipped cutting tools necessary for the practical, low-cost production of the metal parts required for translating ideas into realities.

We have been translating ideas into realities for more than a quarter century. Send us your sketches or outline drawings.

GAIRING

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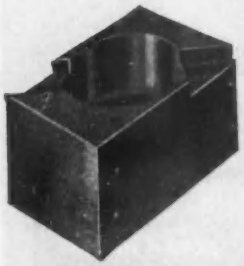
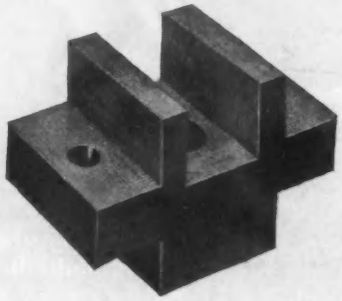
MANUFACTURERS OF STANDARD, SPECIAL AND GAIR-LOCK INSERTED BLADE CUTTING TOOLS

BIG GUN CONTROLS

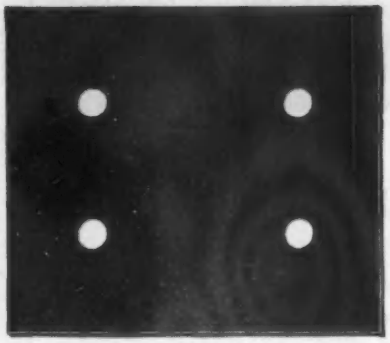
need tough insulation



Black Grade LE DILECTO Gun Director Part, Smooth Sawed, Drilled, Milled, Reamed.



Natural Grade LE DILECTO Support Block, Smooth Sawed, Milled, Drilled.



Punched Black Grade LE DILECTO Insulator.

GRADE "LE" DILECTO a *Laminated Phenolic Plastic* combines good mechanical properties with good electrical insulating qualities.

Tensile Strength	8500 PSI	Dielectric Constant at 1000 KC	5.5
Compressive "	37000 PSI	Power Factor	0.045
Flexural "	19000 PSI	Dielectric Strength 1/8" thick	250 vpm

(Above Figures are NEMA average)

SEND FOR CATALOG "DO" WHICH GIVES COMPLETE TECHNICAL DATA ON ALL DILECTO GRADES

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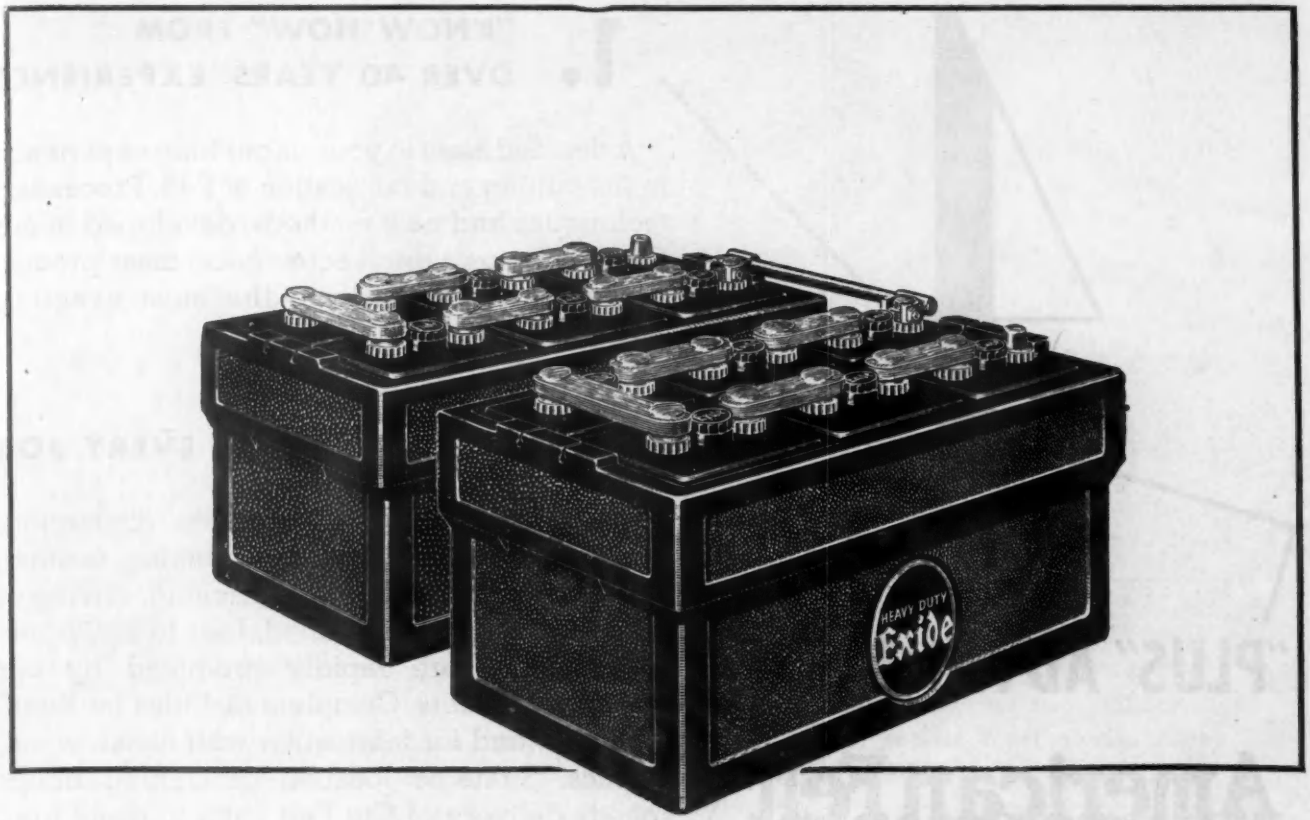

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Everywhere you go you'll find Diesel operators and maintenance men who will always cast their ballot for Exide Batteries. They know that when they select an Exide for a Diesel cranking job, they have the same assurance of complete satisfaction under all conditions as they have in the engine itself.

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plane talk

AVIATION EQUIPMENT NEWS AND FACTS

For *plane, plant* and *port*—Westinghouse builds a complete line of electrical equipment . . .

Send for our new book on X-RAY INSPECTION—B-3159. It's packed with practical, understandable, question-answering information on how and where to use x-ray—how to set up an x-ray department—how to select the right equipment—range of equipment available . . . or, if you want fast action on your problem, call your nearest Westinghouse office and ask for an X-ray Specialist. He'll respond promptly and competently.

One reason for the dependable accuracy of Westinghouse AIRCRAFT INSTRUMENTS is their hard, tough pivots. Made by a special process, these pivots resist blunting . . . protect careful calibrations. Every manufacturing step is carefully controlled. Honing pressure is precisely regulated. Pivots are tumbled to relieve stress and set grain structure. A 500-to-1 contour enlargement of each point is carefully inspected. Photomicroscopic studies and hardness tests check uniformity.

⅓ to ⅔ kv-a of current-carrying capacity is released by every CAPACITOR Kv-a installed. That's why aircraft manufacturers should investigate how CAPACITORS will give them more production from present power supplies . . . eliminate dangers incident to overloaded systems . . . improve lighting and motor performance . . The PRECIPITRON rates special consideration by precision parts manufacturers. Installed in the plant air circulating system, it removes 90% of all harmful dust and dirt particles—down as fine as 1/250,000 of an inch in diameter. Contrast this with the best mechanical filters that remove only 25% of air-borne dust and dirt.

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Literature mentioned in "Plane Talk" . . . additional information on any item can be secured from any Westinghouse office, or by writing Westinghouse Electric & Manufacturing Company, Dept. 7-N, East Pittsburgh, Pa.

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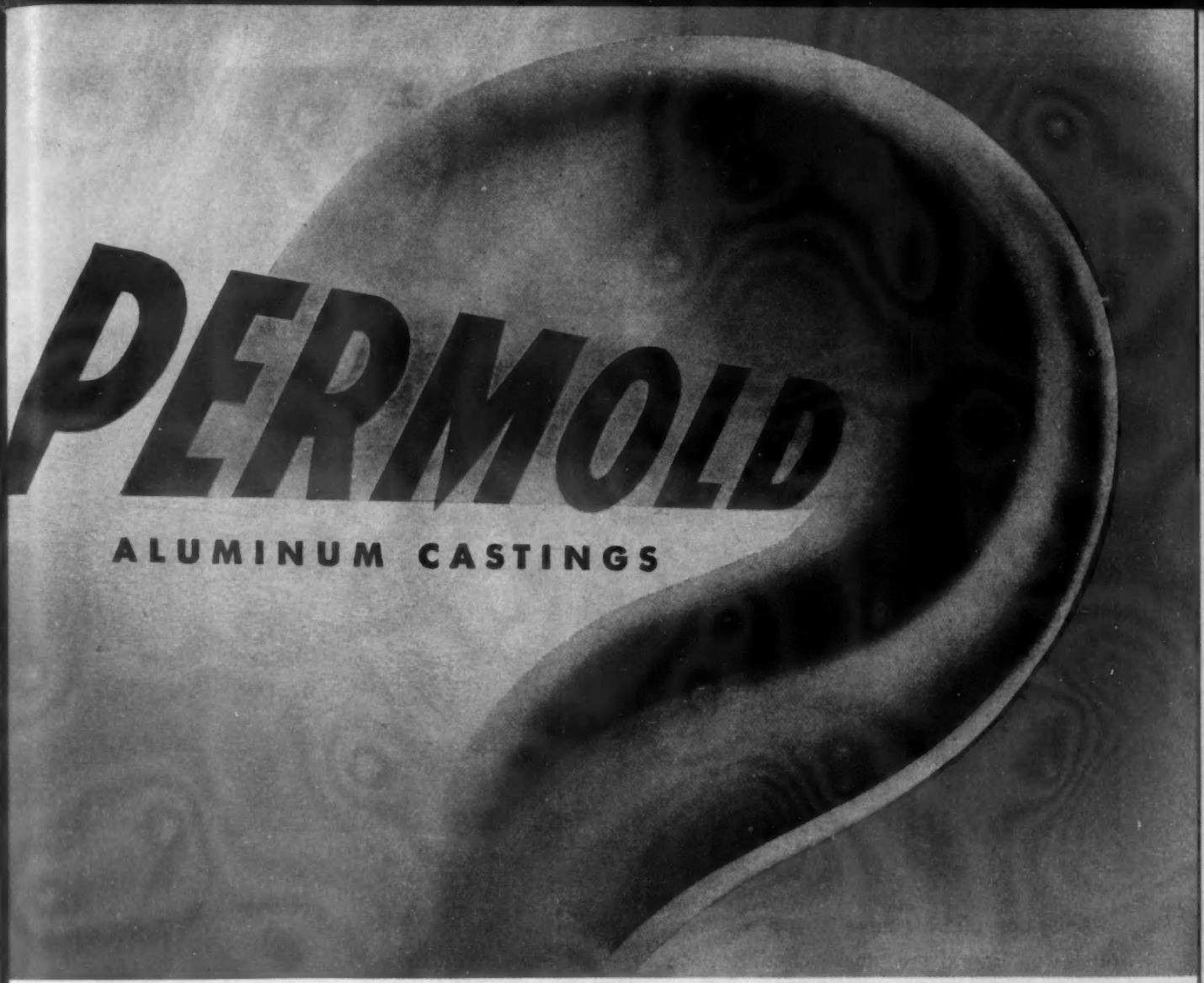
● This new ARO Model 131 Reversible Impact Wrench says "when" automatically—it's the *only* impact wrench with Controlled Torque!

Specially designed to increase the speed and accuracy of nut and bolt setting operations up to ⅜" size...sets bolts and nuts without danger of stretching or "burning".

The simple *impact roller clutch mechanism has only 4 parts* and is so constructed that when predetermined torque is reached, the rollers rebound out of engagement with the hammer, thus avoiding any chance of stretching the bolt. Operator controls torque by merely turning calibrated adjusting screw. Write for new catalog No. 44.

The Aro Equipment Corporation, Bryan Ohio.

THE ARO EQUIP. CORP. ARO BRYAN, OHIO



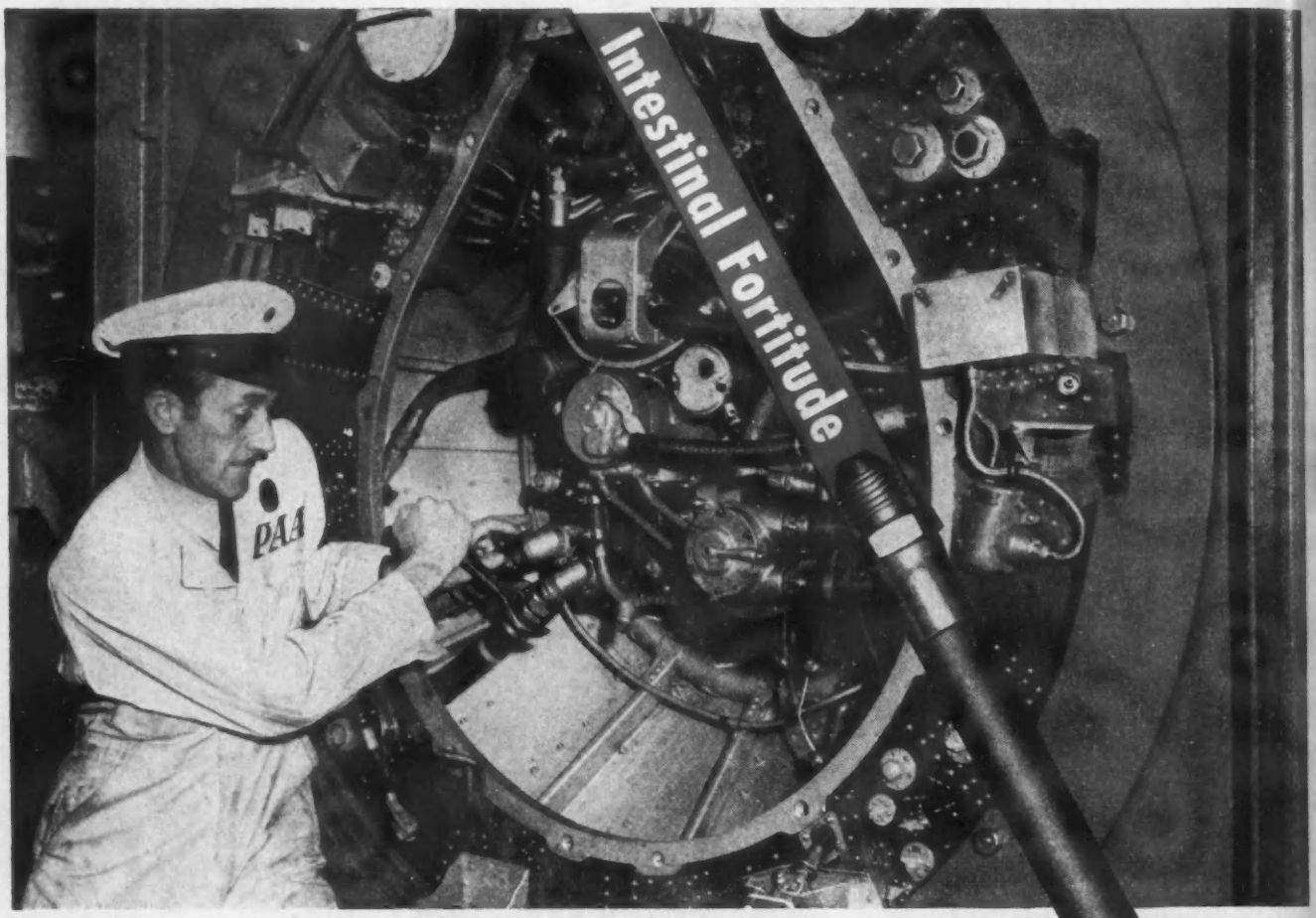
Some Differences That'll Help You WIN THE BATTLE OF COSTS

Whatever controls the rate of production, and the quality, of a part is certain to be a vital factor in the coming battle of costs, to meet postwar competitive conditions. The cost of a part begins with the metal from which it is fabricated. There is an important *difference* between *knowing about* alloys for aluminum permanent-mold-castings and *actually knowing, on the basis of their behavior,* which alloys, whether from virgin or remelt sources, provide the essential physical properties at lowest cost to meet a specified service condition. That's one *difference:* here is another. It is not only the metal of which a permanent-mold-casting is made, but ideas and experience relating to design requirements of such castings, which lead to the employment of the correct permanent-mold-casting technique required to obtain, at lowest cost, the specified physical properties. *Different* permanent-mold-casting techniques not only result in tangible and measurable *differences* in the quality of the castings obtained, but also in minimum scrap loss developed during machining or other processing—*differences* that reduce material and machining time losses to a minimum. It is the presence of a correct combination of these *differences* in Permold aluminum castings that should lead to both a marked improvement in your product and a lower assembly cost. Throughout 23 years of venturesome technical and foundry practice, Permold metallurgists and foundry technicians have acquired a practical knowledge of the *possible differences* obtainable with various alloys for aluminum permanent-mold-castings. Ask a Permold engineer or metallurgist, or both, to identify and explain some of *these differences* that will help you win the coming battle of costs.

THE PERMOLD COMPANY

820 West Liberty Street • MEDINA, OHIO

In the Cleveland Industrial Area



American aircraft have it and are demonstrating that fact on a day after day, round the clock schedule because small aircraft parts as well as large are built on a top quality basis.

Flex-O-Tube hose assemblies, with which the Pan-American Atlantic Clipper is equipped, are a typical example of this. Each of these Flex-O-Tubes is engineered, manufactured and tested for a specific application. They are important small parts.

The same Flex-O-Tube quality needed on long range airliners is one of the reasons for the INTESTINAL FORTITUDE of our fighting aircraft around the globe.

THE **Flex-O-Tube** COMPANY

LAFAYETTE at 14th AVE.,
DETROIT 16, MICHIGAN
Offices: CHICAGO · FORT WORTH
LOS ANGELES · NEW YORK
SEATTLE · TORONTO, ONT.

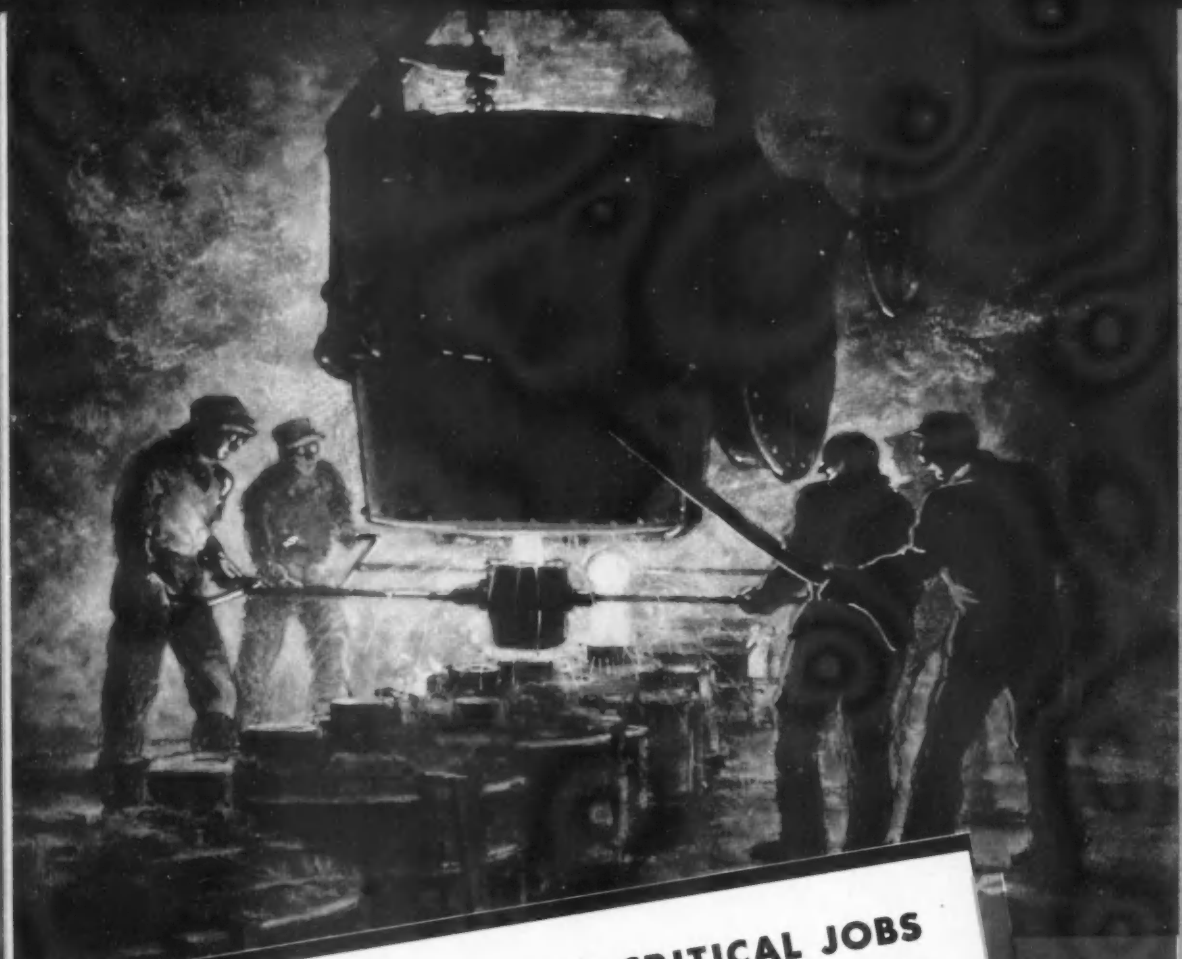
CLARK
Electric Steel
CASTINGS

Made to do a
BETTER JOB

Here's Why . . .

BOTTOM POURING MAKES SURE OF UTMOST PURITY OF METAL, GIVING STRENGTH AND DEPENDABILITY NECESSARY FOR MEETING TODAY'S ENGINEERING REQUIREMENTS — CLARK'S PRECISE METALLURGICAL AND LABORATORY CONTROL OF RAW MATERIALS AND HEAT TREATMENT PRODUCES SOUND CASTINGS WITH VARIED SECTIONS . . .

Another PRODUCT of CLARK EQUIPMENT COMPANY



CASTINGS FOR THE CRITICAL JOBS

In 1913, at Buchanan, was built one of America's first electric furnaces for the production of steel castings—built by Clark. The years that followed have been years of steady improvement in processes and equipment, in metallurgy, and in quality of product.

Out of that zeal for perfection, Clark's usefulness has grown steadily—a usefulness born of increased "Know How" and ability to produce better castings of intricate design and varied sections; castings made to a variety of chemical and physical specifications for carbon and alloy steel; castings of the uniform high quality and finish demanded for critical jobs—in ordnance, in railway and automotive equipment, and in many other industries.

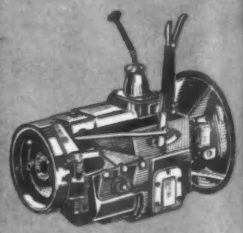
You can use this service to competitive advantage. It's easy to find out how—talk over your problems with Clark foundry engineers.

CLARK EQUIPMENT COMPANY
BUCHANAN, MICHIGAN

Also BATTLE CREEK . . . JACKSON . . . BERRIEN SPRINGS, MICH.

Another PRODUCT of CLARK EQUIPMENT COMPANY

Some CLARK products

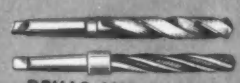


TRANSMISSIONS

BLIND RIVETING PROCESS

AXLE HOUSINGS

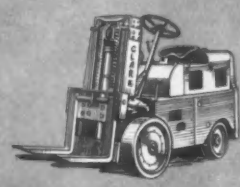
FRONT AND REAR AXLES FOR TRUCKS AND BUSSES



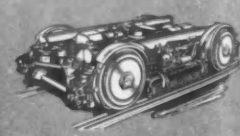
DRILLS AND REAMERS

GEARS AND FORGINGS

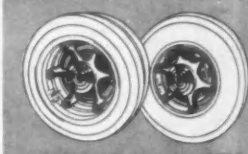
ELECTRIC STEEL CASTINGS



INDUSTRIAL TRUCKS AND TRACTORS



RAILWAY CAR TRUCKS

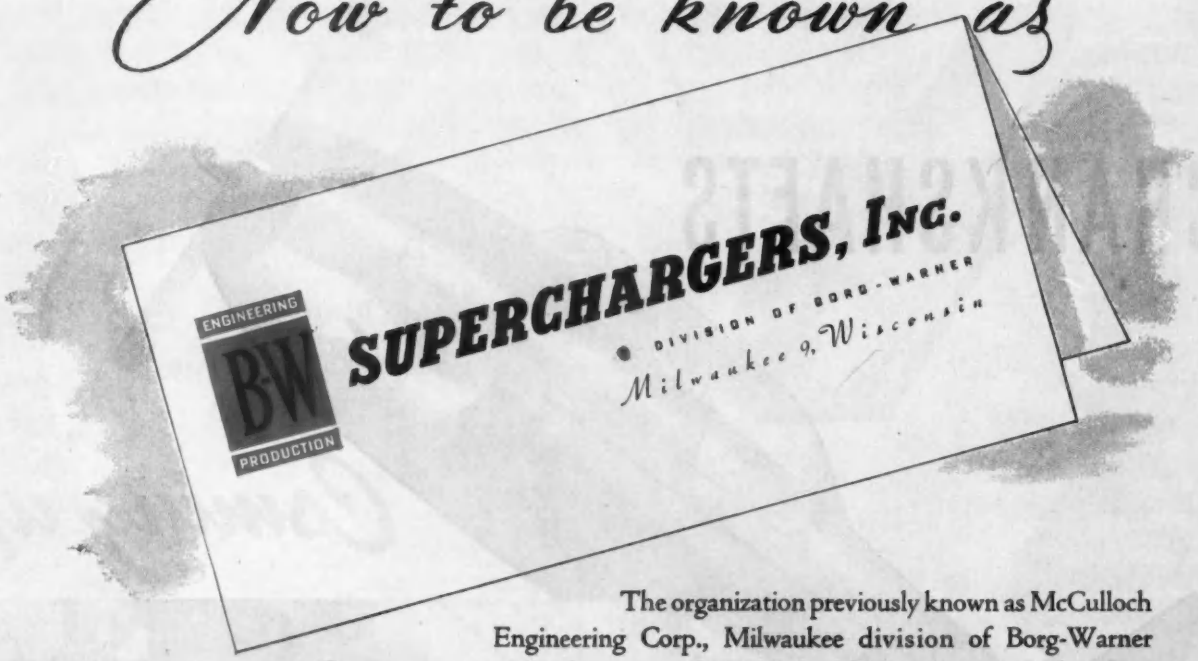


METAL SPOKE WHEELS

CLARK Electric Steel CASTINGS

McCULLOCH ENGINEERING CORP.
MILWAUKEE

Now to be known as



The organization previously known as McCulloch Engineering Corp., Milwaukee division of Borg-Warner Corp. now is to be known as B-W Superchargers, Inc., Milwaukee.

This change of name is intended to emphasize the fact that this company will continue to specialize and concentrate on the production of superchargers for internal combustion engines for transport, stationary, construction equipment and other services.

The modern plant of the former McCulloch Engineering Corp., on Capitol Drive, Milwaukee was originally designed, built, and equipped for the manufacture of superchargers. In response to wartime demands it has supplied superchargers in volume numbers for military installations of all kinds. When peace returns B-W Superchargers, Inc., will continue to build superchargers for increasing the power of gasoline and diesel engines of the future.

Because it is more indicative of its principal activity — the design, development and production of superchargers — the change of name has been made.

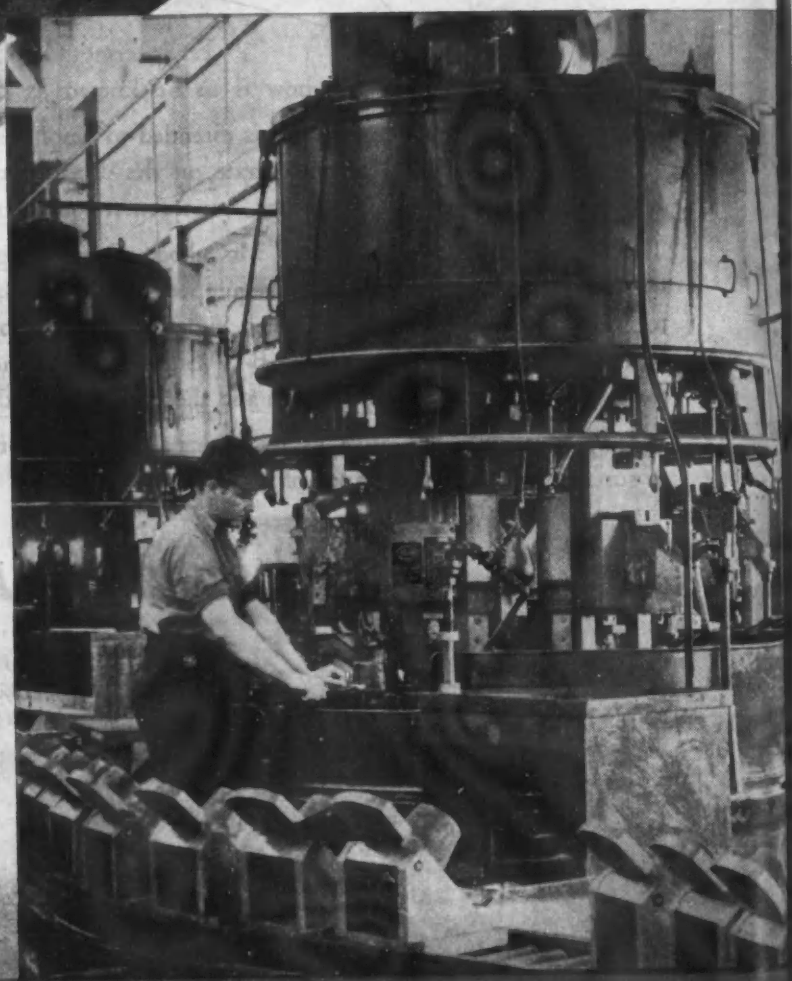
ENGINEERING
B-W
PRODUCTION

SUPERCHARGERS, INC.

DIVISION OF BORG-WARNER
Milwaukee 9, Wisconsin
formerly McCulloch Engineering Corp.

CRANKSHAFTS

Coming up!



BULLARD

THE BULLARD COMPANY

BRIDGEPORT 2, CONNECTICUT

THIRD GENERATION OF DIAMOND EXPERIENCE • THIRD GENERATION OF DIAMOND EXPERIENCE • THIRD GENERATION OF DIAMOND EXPERIENCE

Points of interest to the nation's leading industries . . .

Abrasive RED BAND

DIAMOND TOOLS

Abrasive

DRESSING TOOL COMPANY

Detroit, Michigan

DISTRIBUTOR TERRITORIES OPEN — *Write For Complete Details!*

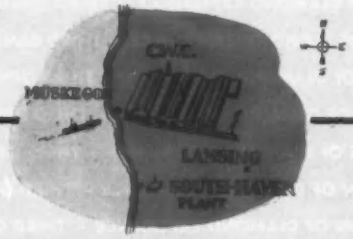
PREVENT EXCESSIVE CYLINDER CORROSION AND WEAR!

C.W.C. CENTRIFUGALLY CAST INSERTS AND LINERS SOLVE THE PROBLEM

C.W.C. cylinder liners and acid-proof inserts, centrifugally cast of electric furnace alloyed metal, provide the real solution to engine wear due to corrosion. Widely used in heavy duty engines, C.W.C. inserts and liners are now available to engine builders in every field.

The C.W.C. centrifugal casting process results in uniform density and structure of metal with high Brinell and excellent machinability. Greatly reduced scrap ratio eliminates wasted production time. Without further aging or heat-treating, C.W.C. cylinder liners and inserts are free from distortion and out-of-roundness. Exact metallurgical control of C.W.C. electric furnace metal produces a product remarkably free from wear.

Write C.W.C. for complete information. Experienced C.W.C. engineers and metallurgists offer their counsel to all interested executives regarding the prevention of cylinder wear and corrosion, or concerning any volume casting problem.



CAMPBELL, WYANT & CANNON

Six foundries in four cities:

Muskegon—Henry Street Plant
Sanford Street Plant
C. W. C. Crankshaft Corporation.

South Haven—National Motor Castings Co.

Lansing—Centrifugal Fusing Co.

Bettendorf, Ia.—Ordnance Steel Foundry Co.

INDUSTRY'S LEADING CONTRACT FOUNDRY ORGANIZATION

CAMPBELL, WYANT & CANNON FOUNDRY CO.

MUSKEGON, MICHIGAN

Here's what the

BRUSH SURFACE ANALYZER

means to them...

● Speed, ruggedness, dependability—the basis of P. T. engine design. Accurate control of surface finish is one of the important factors facing the builder of P. T. motors.

Mated, moving parts must be precision made with surface finish accurately held to low microinch smoothness. The Brush Surface Analyzer provides charts which reveal surface irregularities to one millionth of an inch or less.

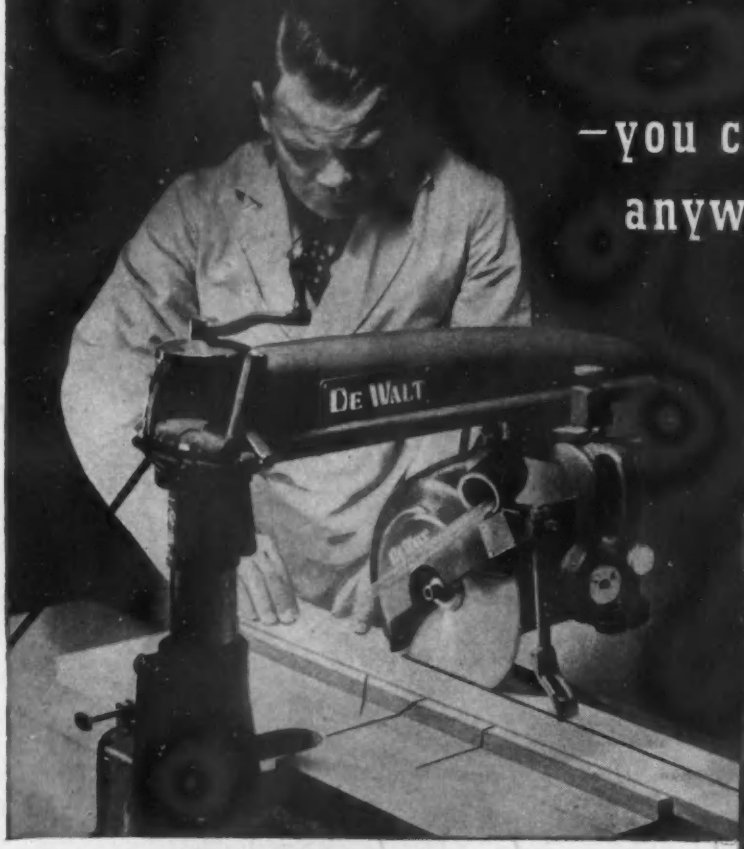
Should accurate control of surface finish be essential in your business, write today for a fully illustrated bulletin on what the Brush Surface Analyzer can do for you.

THE BRUSH DEVELOPMENT COMPANY

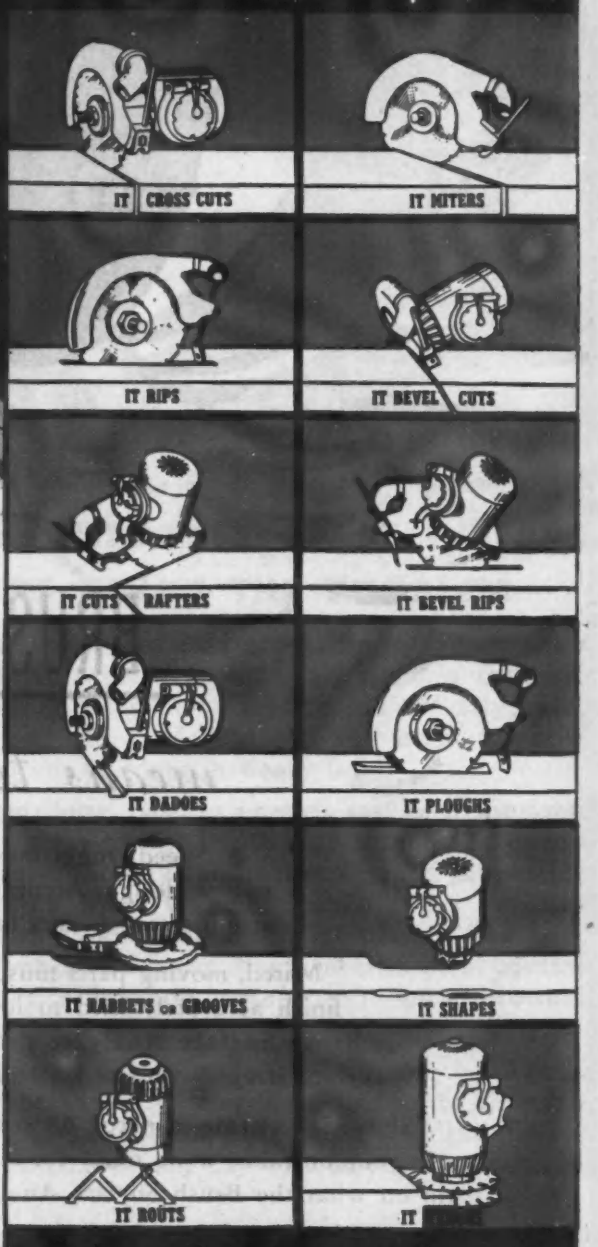
3473 PERKINS AVE.•• CLEVELAND 14, OHIO

Here's a low-cost DE WALT SAW

—you can use for many jobs anywhere in your plant!



STRAIGHT RIPPING



Here's the latest innovation in wood-working machinery!

DeWalt is the answer to industry's need for a safe, easy-to-operate, adjustable, precision cut-off saw—for use in carpenter maintenance, pattern work, crating and boxing, and production wood cutting.

DeWalt is the ALL-PURPOSE machine that can be changed quickly, as required, from a straight-line cut-off saw—to miter saw—to rip saw—to dado machine—to shaper—or other operations that can be made with circular cutting tools.

No matter how, where or when you cut wood, there's a DeWalt that will reduce your cutting costs, conserve labor, simplify materials handling, save floor space, eliminate waste and actually reduce your investment in the wood-working machinery you require.

Illustrated above is the smallest of our many models. It is available in two sizes complete with motor: ½ HP one phase, AC, $125.00; ¾ HP three phase, AC, $135.00. The complete DeWalt line ranges up to 10 HP.

If you're planning to buy a machine—make it a new DeWalt. Mail the coupon below—today!

DeWALT PRODUCTS CORPORATION
5804 Fountain Avenue, Lancaster, Penna.

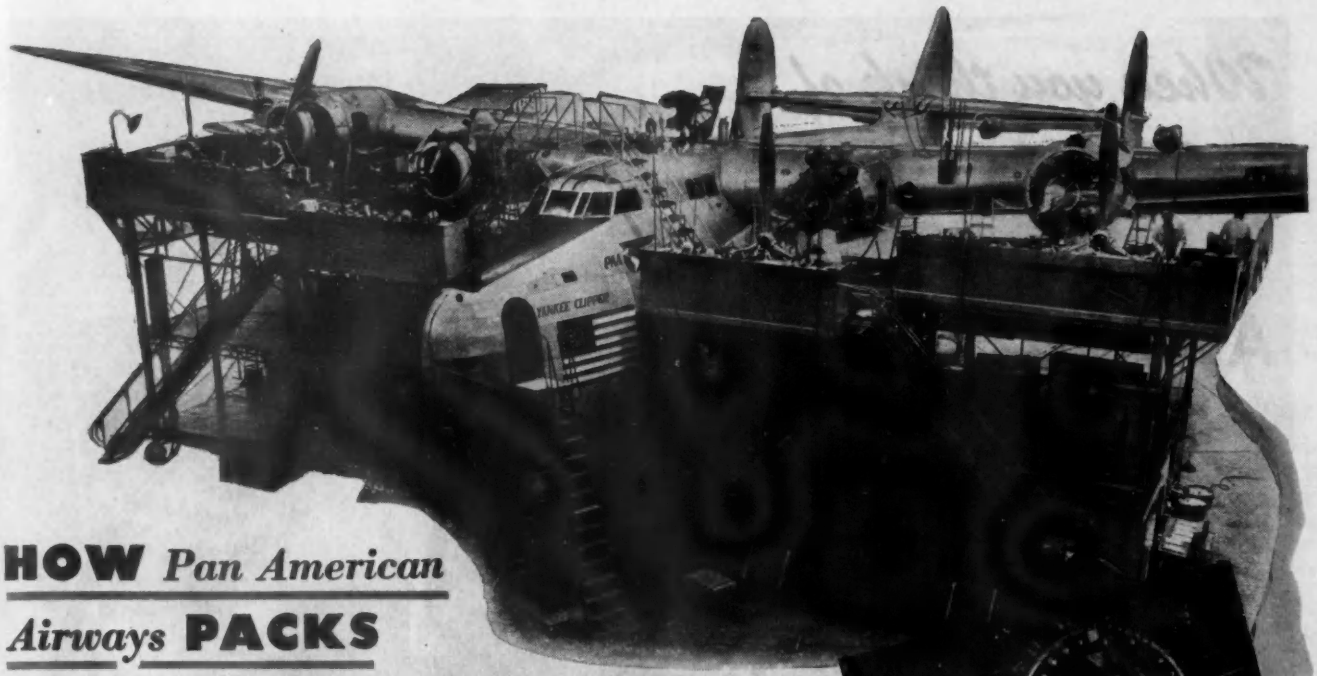
Please send me information on your small DeWalt ☐
Please send me information on your complete line ☐

Address_____

Name_____

City_____ State_____

Makes Every Cut Possible With a Circular Saw



HOW *Pan American Airways* PACKS 2,100 HOURS INTO A DAY

THE minute the giant transatlantic Pan American Clippers get back to their base, they get an exhaustive going over.

It's thorough. And it's fast.

A swarm of mechanics, working in eight-hour shifts, get the job done in 60 hours — 2,100 man-hours a day.

What helps this swift turn-around are Elastic Stop Nuts. These nuts have been on every Pan American Clipper since 1928. They are on motors, mounts, wings and countless structural parts.

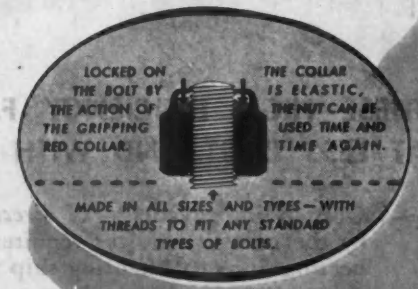
Particularly timesaving are the Anchor Nuts which permit smooth blind mounting. Hundreds of these fasten the covers for inspection openings. These Anchor Nuts* are an Esna development and are used by millions in all kinds of airplanes.

Elastic Stop Nuts lock tight and fast without any auxiliary devices. There's no time wasted in fussing to get them off and back on again.

They lock because of the elastic collar in the top. This collar squeezes in between the bolt threads. It's compressed tight. The nut can't turn. It can't wiggle. It can't shake loose. And you can take it off and put it on again many times and it still locks.

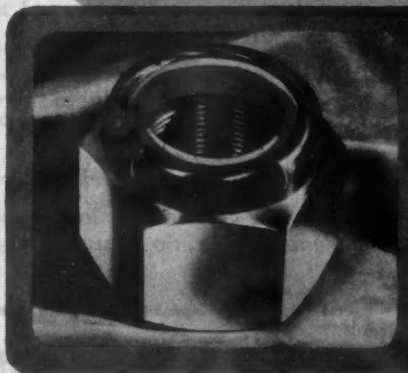
Every fastened product can be better because of these nuts — can be safer, tighter, quieter, and longer lasting.

So if you have a fastening problem now, or see one ahead, let us show you how these red-collared Esna Nuts can help. Our engineers are ready to consult with you and recommend the appropriate nut.


LOCKED ON THE BOLT BY THE ACTION OF THE GRIPPING RED COLLAR.
THE COLLAR IS ELASTIC, THE NUT CAN BE USED TIME AND TIME AGAIN.
MADE IN ALL SIZES AND TYPES — WITH THREADS TO FIT ANY STANDARD TYPES OF BOLTS.

The Clippers' powerful engines are equipped with Elastic Stop Nuts. Overhauling is simplified by the absence of pins, washers, or other auxiliaries.

*ESNA Anchor Nuts allow ready access to inspection openings, yet refasten tight and strong to carry stressed skin loads.



ESNA

TRADE MARK OF
ELASTIC STOP NUT CORPORATION
OF AMERICA

ELASTIC STOP NUTS

Lock fast to make things last

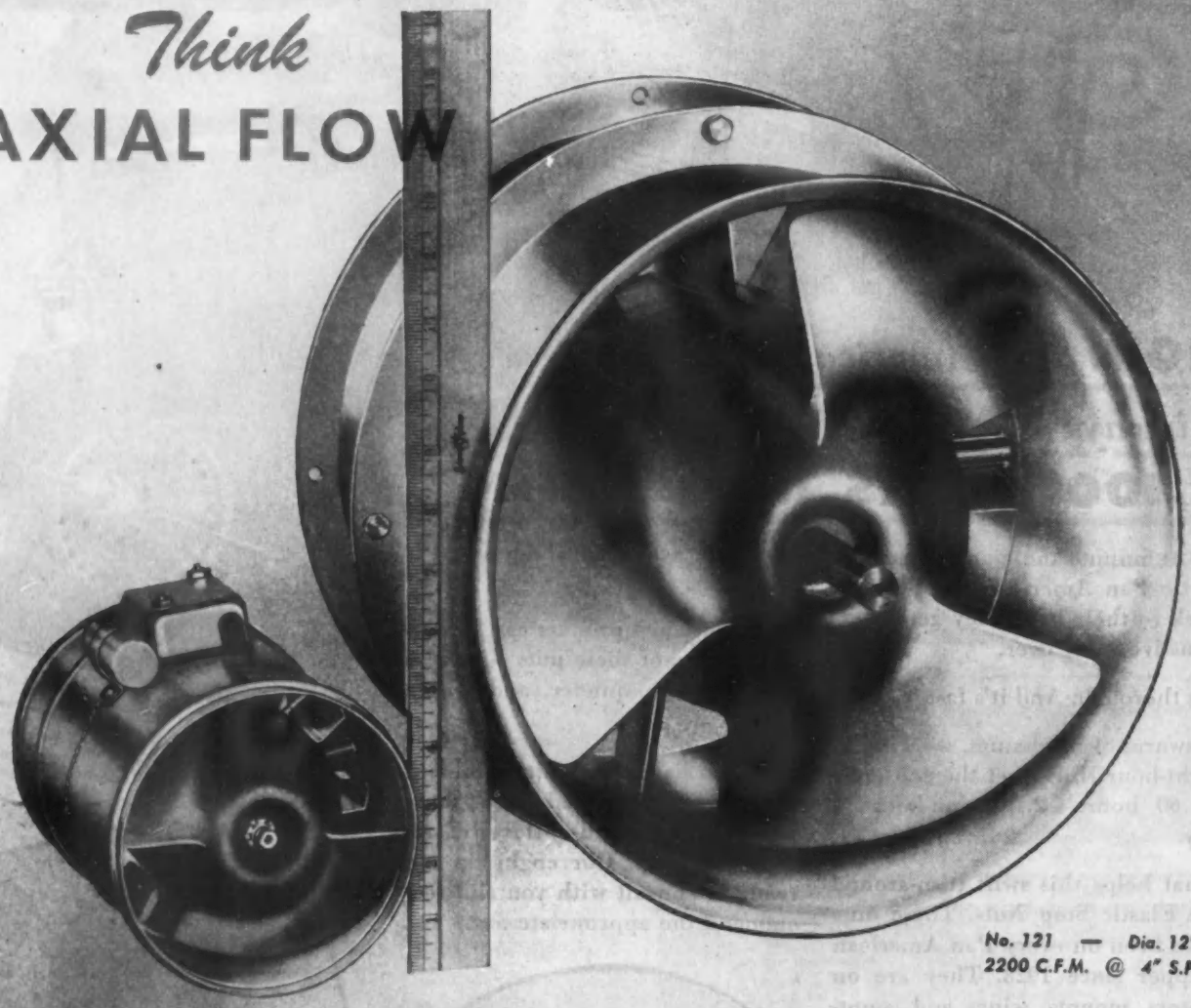
UNION, NEW JERSEY AND
LINCOLN, NEBRASKA

When you think of

MOVING AIR

Think

AXIAL FLOW



No. 121 — Dia. 12"
2200 C.F.M. @ 4" S.P.

NO. 4582 — Dia. 4-3/4"
120 C.F.M. @ 3" S.P.

THESE HIGH EFFICIENCY FANS DO A BETTER JOB AT LESS COST AND WITH LESS WEIGHT AND BULK

Outstanding advantages of *direct* air movement, although mothered by the necessity of war requirements, are not confined to aircraft heating nor small fighting ship ventilation alone. Any job of moving air – particularly where a pressure head is involved – can be handled more efficiently and at lower cost by Dynamic Air Axial Flow Fans.

Illustrated above, in comparison with a small 4¾" aircraft unit, is a 12" diameter, single-stage model, developed for government use. With an input of 2 H.P. at 5100 R.P.M., this unit delivers 2200 C.F.M. at 4" S.P. It can be made in a 2-stage model, practically doubling the pressure characteristics.

With the certainty of long experience we suggest: when you think of moving air, no matter what the requirement – *think Axial Flow.*

DYNAMIC AIR ENGINEERING Inc.
LOS ANGELES, U. S. A.

BUILDERS of HIGH EFFICIENCY AXIAL FLOW EQUIPMENT

★KEEP THAT GUARD UP!

It is not all over but the shouting. • We can still —lose. • Ships are yet to be launched that will win the war. Planes are yet to be built that will win the war. Bonds are yet to be bought that will win the war. • Keep that guard UP, America! This fight isn't over, yet. And a referee's decision won't do. We've just got to win . . . by a knockout.

GENERAL MACHINERY CORPORATION

HAMILTON, OHIO

THE NILES TOOL WORKS CO.

THE HOOVEN, OWENS, RENTSCHLER CO.

GENERAL MACHINERY ORDNANCE CORPORATION

IT IS NOT "ALL OVER BUT THE SHOUTING"

★KEEP THAT GUARD UP!

The score in this war is far, far from conclusive. Production, colossal a year ago, must be greater. More ships, planes, tanks — more of all weapons of war — are needed. Anything can happen. We can still lose. Or win. General Machinery Corporation believes in keeping that guard up . . . and we're making the engines, cannon, machine tools for the finish.

GENERAL MACHINERY CORPORATION

HAMILTON, OHIO

THE NILES TOOL WORKS CO.

THE HOOVEN, OWENS, RENTSCHLER CO.

GENERAL MACHINERY ORDNANCE CORPORATION

★KEEP THAT GUARD UP!

★KEEP THAT GUARD UP!

Keep that guard up, America. • One opponent out means there's one left to beat. • We can only win by two knockouts. • Meantime, the cannon, steam and diesel engines, heavy machine tools from General Machinery Corporation are in there punching.

GENERAL MACHINERY CORPORATION

HAMILTON, OHIO

THE NILES TOOL WORKS CO.

THE HOOVEN, OWENS, RENTSCHLER CO.

GENERAL MACHINERY ORDNANCE CORPORATION

IMPORTANT—

KEEP THAT GUARD UP!

GENERAL MACHINERY CORPORATION

HAMILTON, OHIO

THE NILES TOOL WORKS CO.

THE HOOVEN, OWENS, RENTSCHLER CO.

GENERAL MACHINERY ORDNANCE CORPORATION

BLIND COMPETITION

★ As of today, your competition, postwar, is difficult to predict.

There are two big uncertainties.

What will your former competitors do—what changes and improvements will their products show, and what will their selling prices be?

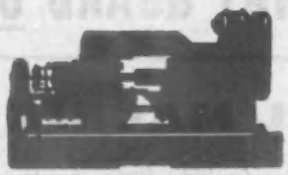
And what new competition will develop from those war plants now approaching the end of their war production, with facilities enlarged and improved?

One thing you can be sure of—your own market position will be better if your manufacturing costs are kept down.

For this cost control, you can safely rely upon modern Acme-Gridley, 4,6 and 8 Spindle Automatics, Bar and Chucking types.

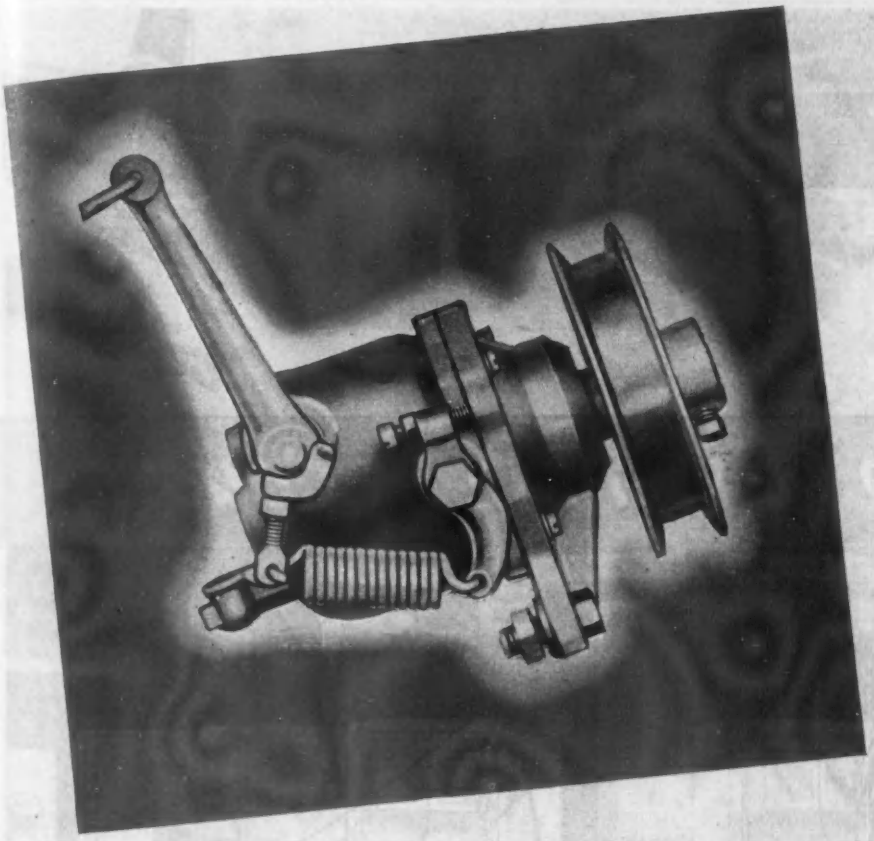
It has been proved that no other production machines can turn out mass production metal parts to finer tolerances, in less time, at lower costs.

A qualified engineer will be glad to show you how these Acme-Gridley advantages—precision time saving and cost reducing—can improve your future competitive position.



ACME-GRIDLEY AUTOMATICS maintain accuracy at the highest spindle speeds and fastest feeds modern cutting tools can withstand.

The
NATIONAL ACME
Company
CLEVELAND · OHIO



This Little Governor Carries Tales

● This is the Pierce Universal Type Governor, designed to drive from the fan belt of the engine—and it's a tattletale.

It is in great demand—by many, many orders every month. And that's the tale—testimony that a substantial percentage of the engines which find their way into uses requiring governing, do *not* provide direct governor driving outlets . . . Testimony, too, that more and more internal combustion engine users, both automotive and industrial, are recognizing the desirability of governing—and the superiority of *mechanical, flyball* governors.

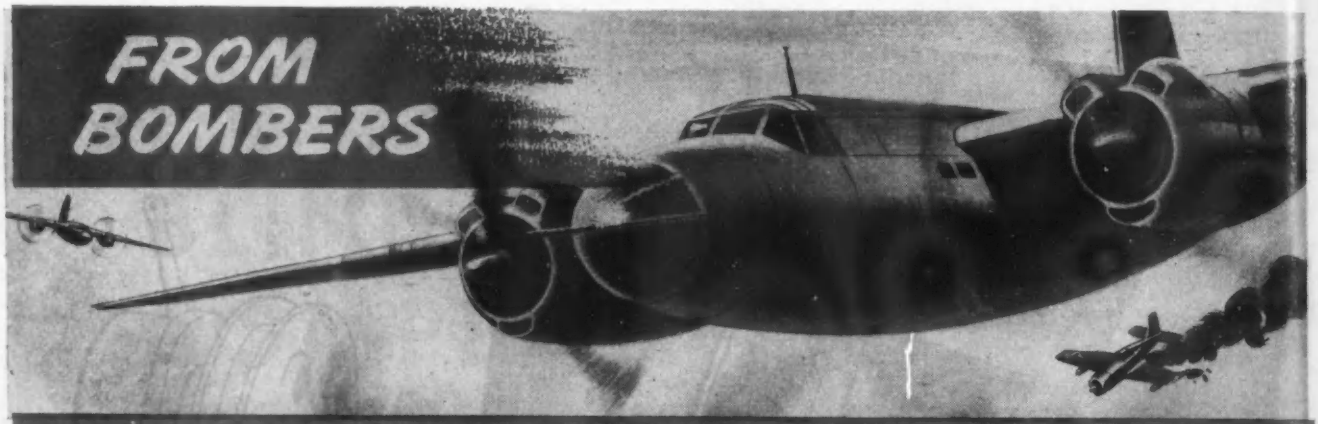
The Pierce Universal Model, of course, is a *good* governor—differing from many other Pierce assemblies only in the use of a drive pulley instead of a gear. But any governor user knows that he gets more efficient and more economical performance—and longer trouble-free service—with direct gear drive than with belt drive.

There are many easy and inexpensive ways to include a direct drive outlet in engine design—and thus materially benefit this growing number of governed engine users. Pierce engineers are always ready to assist in design to this end—and their advice comes from years of practical experience in meeting and solving governor problems on all kinds of internal combustion engines.

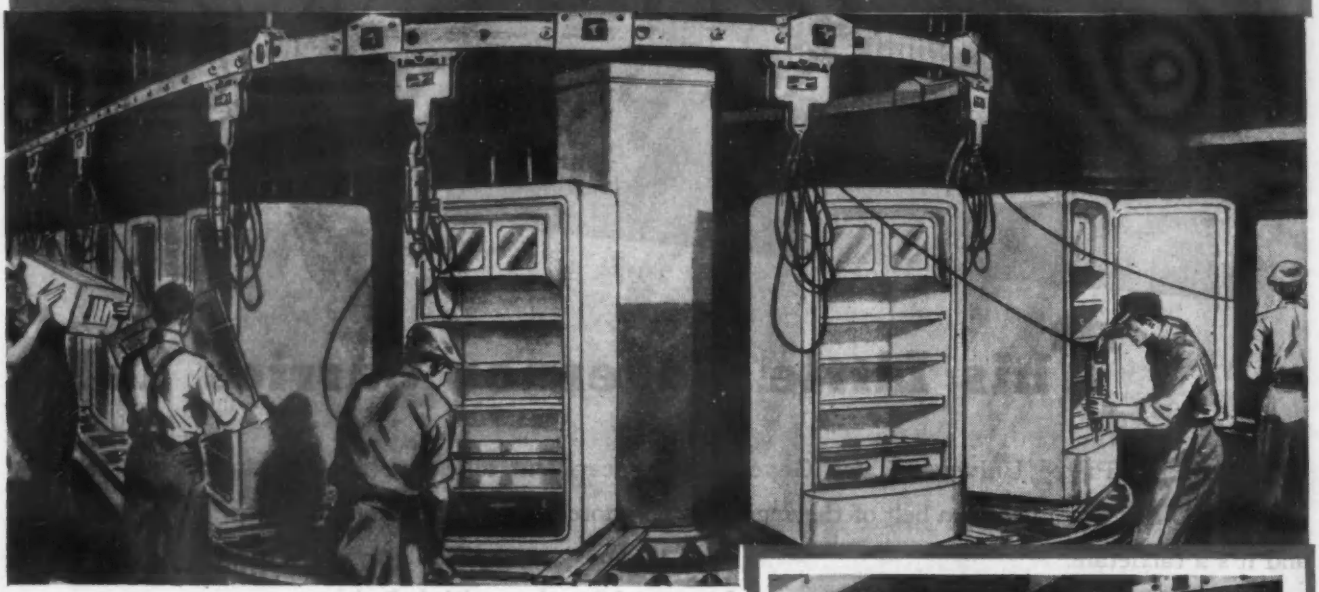
THE PIERCE GOVERNOR COMPANY, INC.
1637 OHIO AVENUE • ANDERSON, INDIANA
Manufacturers of Pierce Precision Governors and Sisson Automatic Chokes
Canadian Manufacturer and Distributor: BURLEC LIMITED, Toronto 13, Canada

PIERCE GOVERNORS

FROM BOMBERS



... BACK TO PEACETIME PRODUCTS



BullDog Will Speed Reconversion

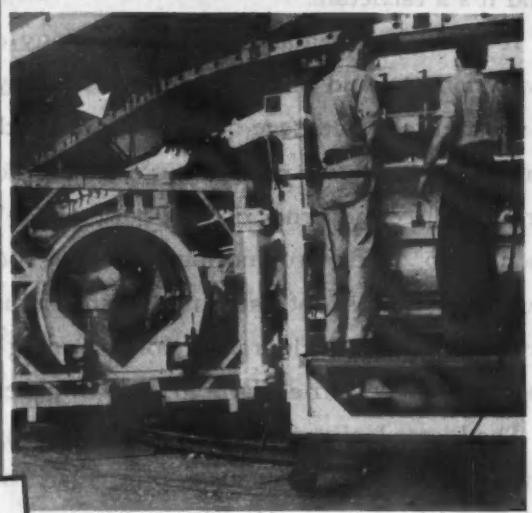
There's a big peacetime job ahead for portable tools, cranes, hoists and other "moving loads" . . . as big a job as they have had in the last three years of war production.

And, when reconversion starts, plants equipped with BullDog Industrial Trol-E-Duct will find their mobile power problems solved.

Only Industrial Trol-E-Duct has fully met the need for safe, convenient, flexible power that travels along with the tool or other moving load. Like other BullDog bus duct systems, it can be quickly moved to any location — readily adapted to any shop set-up.

We invite you to call on expert BullDog engineers for help in your reconversion planning — and we'll send descriptive folders promptly on request.

Help Invasion Roll — Buy More War Bonds



No more open trolley wires — no more long, dangling cords — with BullDog Industrial Trol-E-Duct. Safety goes up, production losses go down, and big savings are effected in wiring and fixed equipment. Not only as a feeder for portable tools on moving assembly lines, but also as a feeder for cranes and hoists—Industrial Trol-E-Duct is an indispensable helper in all kinds of plants.

BULLDOG
ELECTRIC PRODUCTS CO.

BOX 177, R. PK. ANNEX
DETROIT 32, MICHIGAN
BullDog Electric Products of Canada, Ltd., Toronto, Ont.

Field Engineering Offices in All Principal Cities

ALSO MANUFACTURERS OF
VACU-BREAK SAFETY SWITCHES • SWITCHBOARDS
• SAFTOFUSE PANELBOARDS
• CIRCUIT MASTER BREAKERS
• BUSDUCT SYSTEMS

FOR STOP-OFF PLATING

Du Pont Potassium High-Speed Copper Plating

FOR RAPID, consistent production of stop-off deposits on steel parts which are to be selectively hardened, consider what Du Pont High Speed Copper Plating offers.

HIGH SPEED—In 10 to 15 minutes smooth, impervious and uniform deposits of 0.001″ or more in normal commercial operation . . . plating at 40 to 80 AS/F—equivalent to 80 to 160 AS/F for the usual bivalent solution.

LOW COST—Drag-out recovery is practical and lends to economical operation. At the high operating temperatures, water evaporates from the solution and may be replaced by rinse water, thus returning drag-out to the plating tank.

STABILITY—Solutions do not decompose over long periods of time, in operation or when idle. *No poisonous or objectionable fumes are evolved.*

LOW METAL CONCENTRATION—For normal speed of operation, low concentration Potassium (RH-661) baths may be used. Drag-out loss is low, rinsing is easy and solutions are easily filtered.

Du Pont High Speed Copper Plating Solutions are ideal for large-scale commercial operations. Since introduction, over 10,000,000 lbs. of copper have been plated from these high speed copper baths. Du Pont Technical Service has had many years of experience with the installation and operation of plating solutions and will be glad to help in the development and installation of a suitable plating process to meet specific requirements. Just call or write our nearest district office. E. I. du Pont de Nemours & Co. (Inc.), Electroplating Division, Wilmington 98, Delaware.

Don't pay over ceiling prices!
Don't buy on the black market!

KEEP PRICES DOWN!

DU PONT
REG. U. S. PAT. OFF.

DU PONT CHEMICALS • PROCESSES • SERVICE

for ELECTROPLATING

Better Things for Better Living . . . *Through Chemistry*

These MOTOR MOUNTS

QUIET

2000 hp

Does this
RUBBER-TO-METAL JOB
Suggest any
NEW APPLICATION?

Take thousands of terrific explosions per minute in the greatest power plant ever devised . . . add the sudden stresses of pulling out of power dives—the twists of combat maneuvers, the strains of holding a dead engine . . . and you get some idea of the world's number one vibration dampening job.

This problem is licked on many planes today by the motor mount shown above. Our work is a contribution to the engineering of the core assembly; a series of steel plates bonded together and to the core by rubber in such a way that it passes all Air Corps tests for adhesion and shear rate.

This example suggests our ability to handle rubber-to-metal adhesion and may indicate to you new applications for postwar products. We will be glad to place our engineers and laboratory at your disposal.

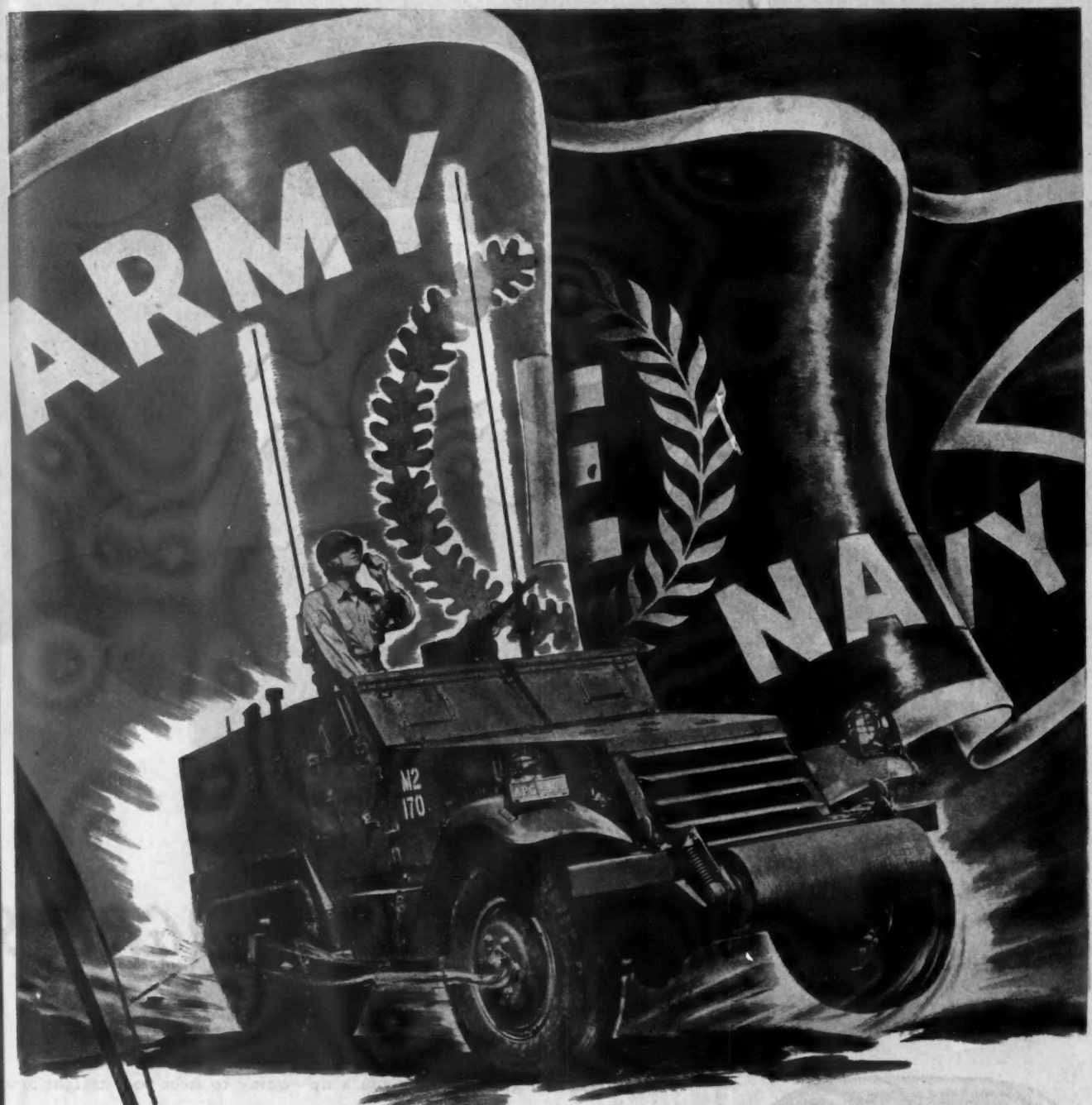
Write for the IDEA chart and suggestion blank.

Also
Precision Molders of many other parts of synthetic soft rubber to meet close specifications now called for by the Air Corps.

THE CONNECTICUT HARD RUBBER CO.

423 EAST STREET, NEW HAVEN, CONN.

Custom Rubber Molders Since 1920



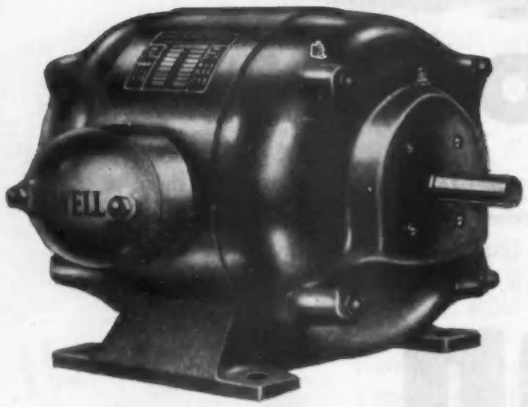
Yesterday and TODAY

The Army-Navy Production Award for outstanding achievement in producing vitally important materials essential to the war effort will be an added incentive to the management and employees of **WARD PRODUCTS CORPORATION** to keep producing more and better equipment for the men who are doing the fighting. While yesterday **WARD** Antennas were accessories for pleasure, today they are implements of War.

WARD *Antennas*

THE WARD PRODUCTS CORPORATION, 1523 EAST 45TH STREET, CLEVELAND, OHIO

KEEP PACE WITH PROGRESS



The Howell Protected Type Motor, shown, gives complete protection against dripping liquids, metal chips and other falling particles. Completely streamlined — utilizing non-breakable steel frame — malleable or steel base — cast iron end plates and cast iron, weatherproof terminal box are standard construction features. Special horizontal and vertical mountings are available.

Available in sizes 5 H.P. and smaller.

ELECTRICIAN: What are *you* doing here?

HORSE: I'm going to give you a tip—going to steer you straight to th best buy in electric motors.

ELECTRICIAN: We've been buying motors from the same firm for 17 yea —we know motors.

HORSE: That's just it. A lot of improvements have been made since yo first investigated motors. Take Howells, for example. All our motor are precision-built—many of them are specially built for the job the are to do. Today, we're building specialized motors for machine tool ventilating fans, air conditioning equipment, dairy work, almost ever job you can name. And Howell Motors are doing these jobs at lowe costs and with less trouble.

ELECTRICIAN: You mean you will furnish specialized motors for my job Why, I thought I had to take standard motors! I guess I better kee pace with progress.

Get acquainted with Howell Motors now. Phone the nearest Howell representative or write direct to the factory.

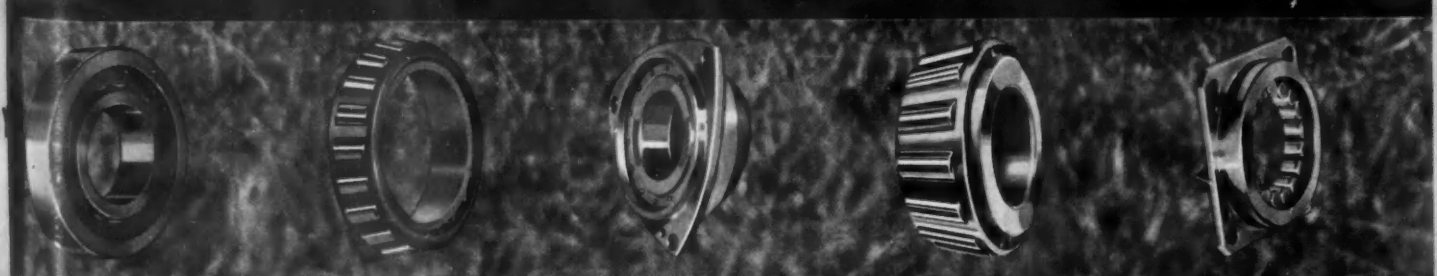
HOWELL ELECTRIC MOTORS COMPAN

HOWELL, MICHIGAN

Manufacturers of Quality Motors Since 1915

OMBERS GET THEIR BEARINGS

BOWER
ROLLER BEARING CO.
Detroit, Michigan



METAL STAMPINGS OF QUALITY

ARMY E NAVY

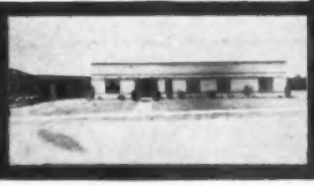
The Metal Specialty Co. is completely equipped to give you efficient service in Stamping, Rolling, Coining, Forming, Drawing and Annealing in all Metals. Specialists in Hydraulic cold drawing and embossing in all metals including stainless steel. Deep drawing and embossing up to 850 tons capacity. Shells drawn up to 20" in depth. Assembling including Spot Welding and Hydrogen Brazing. Pressed Metal products to order.

A complete Plastic Injection Molding Division to fulfill your exacting requirements. Up through 18 oz. moldings.

MAIN OFFICE — PLANT
Este Ave. & Orient Streets
Cincinnati 32, Ohio

BRANCH OFFICE — SALES OFFICE
South L Street
Richmond, Ind.

SALES OFFICE
West Grand Blvd.
Detroit, Mich.



The
METAL SPECIALTY *Co.*

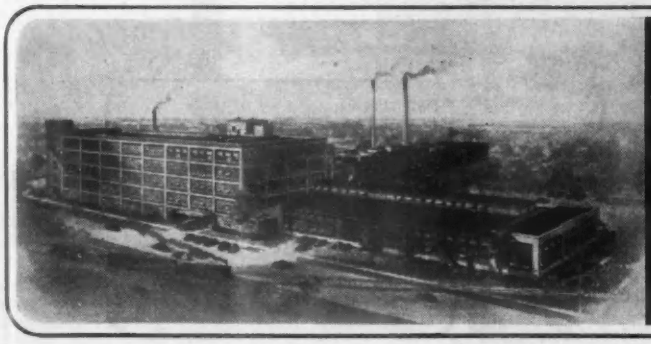
MAIN OFFICE AND PLANT • ESTE AVENUE • CINCINNATI, OHIO

It is also necessary to be Prepared for Peace

As long as they are needed, King-Seeley will continue to concentrate all its facilities and energy in the production of ammunition components and a variety of parts for combat vehicles, aircraft, landing barges and fire control systems.

BUT when G. H. Q. flashes the signal, this organization will, with renewed enthusiasm, resume its service to the automotive industry in the production of instruments, instrument clusters, speedometers, governors and oil filters.

Our reconversion has been carefully planned. It can be made promptly enough to prevent delays in the production of victory models in both automobiles and trucks.



KING-SEELEY CORPORATION

ANN ARBOR MICHIGAN

BAUER & BLACK Industrial Tape

Not "What does it cost?"

. . . but "What will it DO?"

What you *pay* for industrial tape is never the real measure of its cost . . . or of its ability to do the jobs you want done.

The only way to get real economy is to select the right kind of tape for every application.

That's why we concentrate on discovering what your tape problems are . . . why we test tape under such severe conditions . . . *before* we recommend it for your use.

So when you use Bauer & Black Industrial Tapes, you have more than "just tape"... you have a production tool—fitted exactly to the job ahead . . . the tape *proved* right by actual test.

Let Us Study Your Problems with You

For more than forty years Bauer & Black Laboratories have been developing and producing many kinds of adhesives, from fine sterile surgical tape to rugged tapes for every industrial need.

Many major tape achievements have grown from Bauer & Black research . . . the first successful sterilization of surgical tape . . . climate proof tapes for use all over the world . . . and many others.

Experience like this *can* help solve your tape problems.

Conservation Service

Tape users in many branches of industry have saved from 15% to 40% of their annual tape bill through our Conservation Service.

Write or call Dep't 38 and set a time when our sales engineers, working with your own production staff, may help you with specific data on the economical application of Bauer & Black Industrial Tapes.

A Product of

BAUER & BLACK

Division of The Kendall Company

2500 SOUTH DEARBORN ST., CHICAGO 16, ILLINOIS

RESEARCH TO SPEED AND IMPROVE METHODS . . . PRODUCTION SHORT CUTS TO REDUCE COSTS

★ ★ ★

100 TON

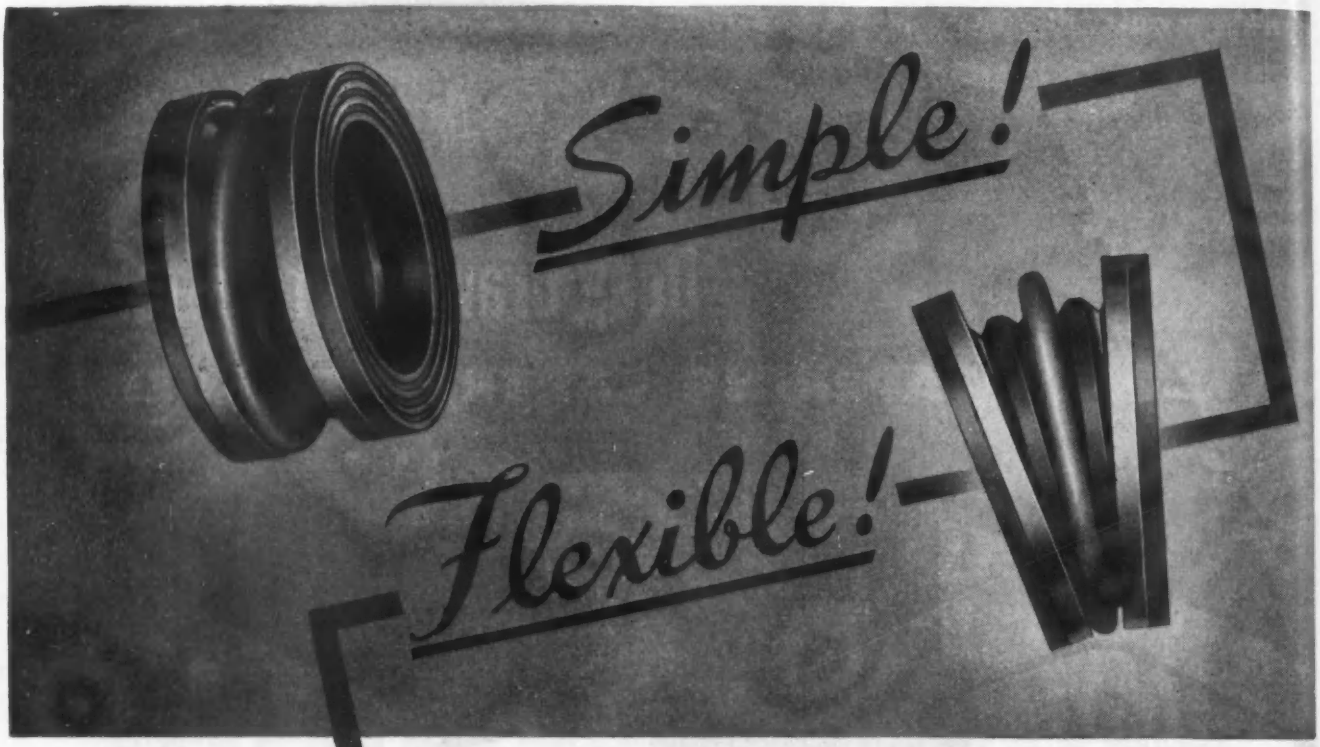
Deep Drawing Press for

TAPERING CARTRIDGE CASES

Built for a famous arsenal, this press, like many other Baldwin hydraulic presses, is equipped with push button controls. The Baldwin Locomotive Works, Baldwin Southwark Division, Philadelphia, Pa., U.S.A. Offices: Philadelphia, New York, Chicago, Washington, Boston, Cleveland, St. Louis, San Francisco, Houston.

BLW THE BALDWIN GROUP

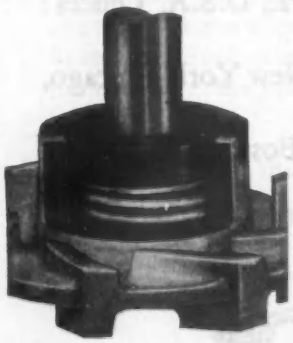
BALDWIN
SOUTHWARK
HYDRAULIC PRESSES



The JOHN CRANE Bellows PUMP SEAL

Standard Equipment in the Engine Circulating Pumps of Jeeps—Tanks—Trucks—Aircraft

Simple Design for easy installation on the production line or in replacement—*Flexibility* to compensate for normal variations in machining the seal cavity—and *Perfect Sealing Performance*—three basic reasons why millions of John Crane Bellows Seals are in use today.

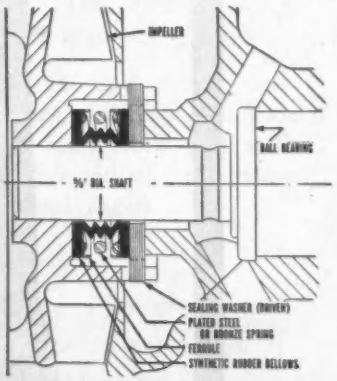


Seal and Washer in Operating Position (Under Load)

Quick Installation is assured. Just slip the Bellows Seal into position, either end first (the two ends are identical). It seals on the end flanges, not on the shaft, and slides on freely. Then slip a Sealing Washer into place to complete the installation.

The Bellows Unit and Sealing Washer rotate with the impeller; there is no wear on the bellows assembly. The helical spring and synthetic rubber bellows are flexible, and adjust automatically to maintain an effective seal. Available in sizes for 5/16″ to 1¼″ shafts.

Send for illustrated Bellows Seal Bulletin. Our Engineering Department will be glad to work with you in making proper application to your pumps.



Typical Installation

CRANE PACKING COMPANY
1818 CUYLER AVE. • CHICAGO 13, ILL.

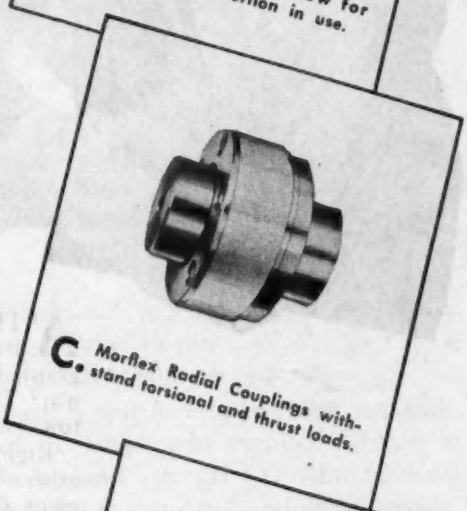
BALTIMORE, BOSTON, BUFFALO, CLEVELAND, DALLAS, DETROIT, HOUSTON, LOS ANGELES, NEW ORLEANS, NEW YORK, PHILADELPHIA, PITTSBURGH, SAN FRANCISCO, ST. LOUIS, TULSA

CRANE PACKING CO., LTD., Hamilton, Ontario, Canada.
Branches: Montreal, Toronto, Vancouver

A Size and Type of COUPLING for every need... MORSE

A. Morse Roller Chain Couplings distribute heavy load stress.

B. Morflex Couplings allow for maximum distortion in use.



C. Morflex Radial Couplings withstand torsional and thrust loads.

D. Free Wheeling Clutch Couplings for standby power, selective drive service.

Closely associated with the design and operation of power transmission equipment is the proper selection of Flexible Couplings. That is why Morse through its years of experience in this field has concentrated on the manufacture of a line of couplings that properly suits most kinds of service.

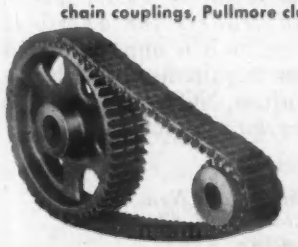
A. Morse series DRC couplings consists of only three all steel parts: two sprockets and a length of Morse "American Standard" Double Roller Chain. The use of double chain increases sprocket tooth bearing areas, affording greater power capacity for given over-all diameter.

B. Standard Morflex Couplings derive their flexibility from a floating center assembly to which two steel hub members are separately connected through resilient rubber trunnion blocks. This design prevents metal-to-metal contact, allows for maximum distortion without loss of efficiency.

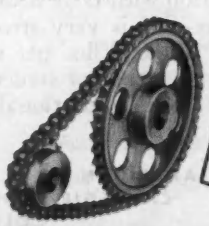
C. The Morflex Radial Coupling is constructed with a series of rubber trunnion blocks assembled on equally spaced pins extending radially from the hub member, and supported in a two piece metal housing, withstands both torsional and thrust loads.

D. Free Wheeling Clutch Coupling: A chain coupling provided with a Morse precision Free Wheeling clutch for standby power units, or selective drive service.

Other Morse precision products include silent and roller chain drives, sprockets, silent chain couplings, Pullmore clutches, automotive timing chains and marine transmissions.



Whatever your power transmission problem may be, remember that 40 years of Morse Chain experience in the design, research and manufacture of dependable power transmission equipment are available to you. Consult Morse for this service.



SPROCKETS CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE Roller and Silent CHAINS

MORSE CHAIN COMPANY • ITHACA, N.Y. • DETROIT 8, MICH. • A BORG-WARNER INDUSTRY

Build light with COR-TEN

. . . TO MEET THE CHALLENGE OF A POSTWAR WORLD

AFTER the war, what? Will a jeep driver take four-wheel drive for granted on the bus he handles after the war? The trucks and trailers of tomorrow—what will they be like?

Right now, one guess is as good as another. But certainly, this new equipment will be *light in weight*. And it will have to be strong, too, to stand up under the faster speeds and heavier duty that seem certain for the future.

That is why we remind you now of the weight-saving possibilities of construction with U·S·S COR-TEN.

COR-TEN is very strong — its yield point (50,000 lbs. per sq. in. min.) is 1½ times that of structural steel. Because of its exceptionally high endurance limit, COR-TEN has an amazing capacity to absorb shock and vibratory stresses. In addition, COR-TEN has high corrosion resistance—4 to 6 times greater resistance to atmospheric corrosion than plain steel.

You can again get the benefits of COR-TEN construction

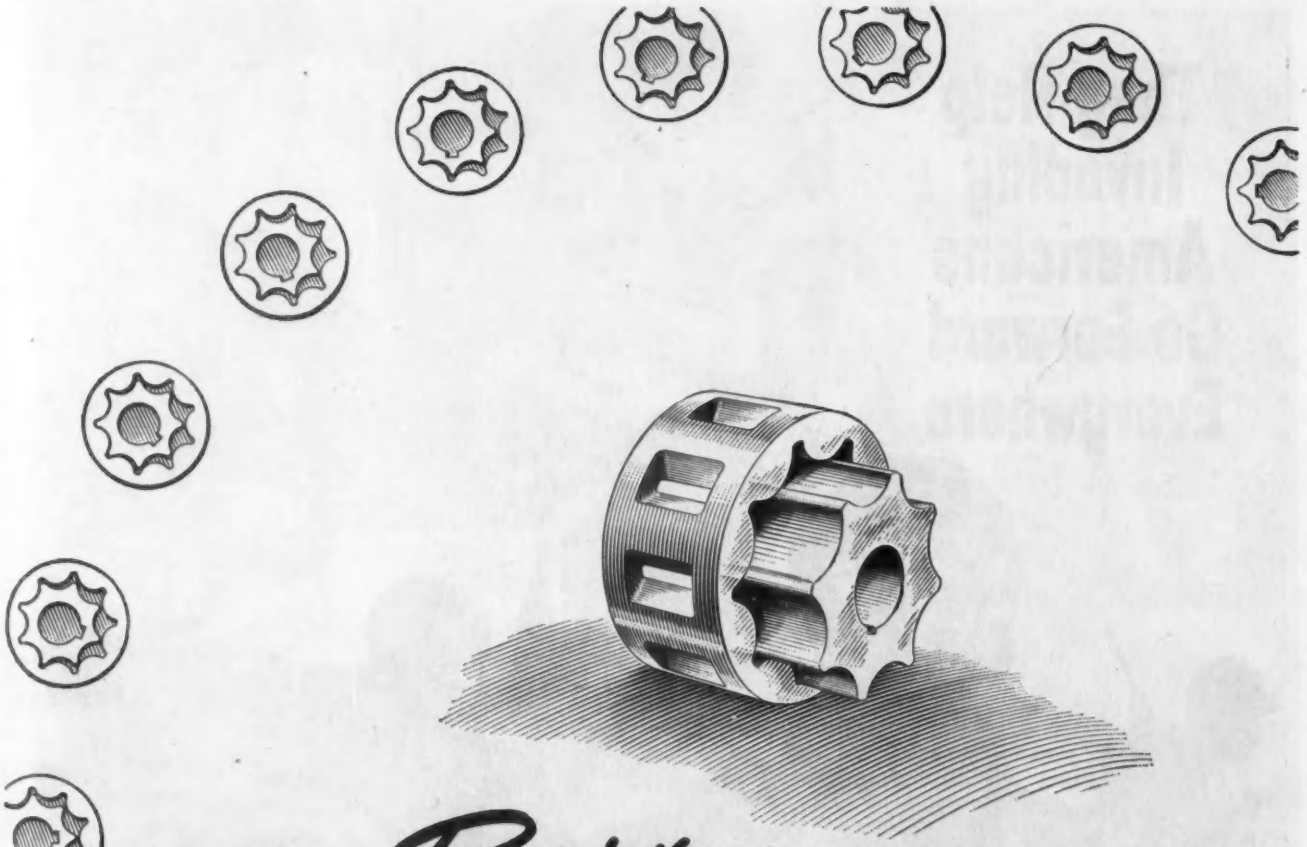
It has been indicated that this year U·S·S COR-TEN *will again be available in increasing quantities for the construction and repair of buses, trucks, tractors and trailers for approved civilian service.* So it is important that you file your requirements with the proper authorities, NOW—and send us your inquiries without delay.

USS

High Strength Steels

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
NATIONAL TUBE COMPANY, *Pittsburgh*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
United States Steel Supply Company, Chicago, *Warehouse Distributors*
United States Steel Export Company, New York

UNITED STATES STEEL



Mass-Precision

put this "shelved" idea to work

The principle behind this handful of odd-shaped parts long lay on the "good-ideas-but-can't-be-done" shelf. Engineers who recognized the Gerotor's value in theory discounted its practical possibilities...until it was put up to Nichols.

The stumbling block: Finding ways to produce the inner part to mate with the outer on an interchangeable-parts-and-assembly basis...to extremely close tolerances.

Yet, this principle was too important to remain permanently on the shelf, because it blueprinted a metering pump that could discharge a continuous, *measured* flow of liquid and at the same time draw in a fresh supply. As the inner gerotor revolves continuously in the outer gerotor, the tooth space progressively increases during half a revolution, and simultaneously decreases in its opposite half. The cavity on the increasing side provides the intake, while the cavity on the decreasing side provides the discharge.

Today "the pump that couldn't be made," is not only being produced by W. H. Nichols & Sons but is being assembled without any pre-selection of its parts...something a leading technological institute flatly said was impossible.

In engineering this unit to mass-precision standards, Nichols designed and built special machines and tools to contour grind the hardened inner gerotors and to finish the outer gerotors...applied its thorough knowledge of lapping, as well as accurate hole-sizing and locating. And achieved a compact mechanism that answers today's engineering requirements for light weight, high speed and low price... plus long life.

Your interests may not include Gerotors or pumps of any kind, but the ability of Nichols to bridge the gap between good ideas and their practical mass-production may turn one of your "shelved" post-war blueprints into profitable reality.

Put their future up to "Accurate" Nichols.

W. H. NICHOLS & SONS, WALTHAM 54, MASS.

"Accurate" *Nichols*

ni

PRECISION ENGINEERING AND MANUFACTURING FACILITIES FOR MASS PRODUCTION

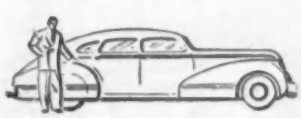
Illustration is from Inland poster showing operation in the production of the Inland-made carbine.

The battle-worthiness of the Inland-made Carbine has been proved by gallant American foot soldiers in landing operations all over the world. Light and maneuverable, this vicious little .30 calibre gun easily and quickly fires 15 high-velocity slugs from one clip with deadly accuracy.

Called an outstanding development of the war, the Carbine is a prime example of Inland's versatility in engineering and manufacturing. Its production achievement—starting from scratch—has gained Inland wide recognition for many important contributions to the technique of mass production of firearms.

The Carbine is one of many Inland products for Victory which are helping to give fighting fire-power to invading Americans on the beaches of France, Italy and the South Pacific.

INLAND MANUFACTURING DIVISION, General Motors Corporation, Dayton, Ohio

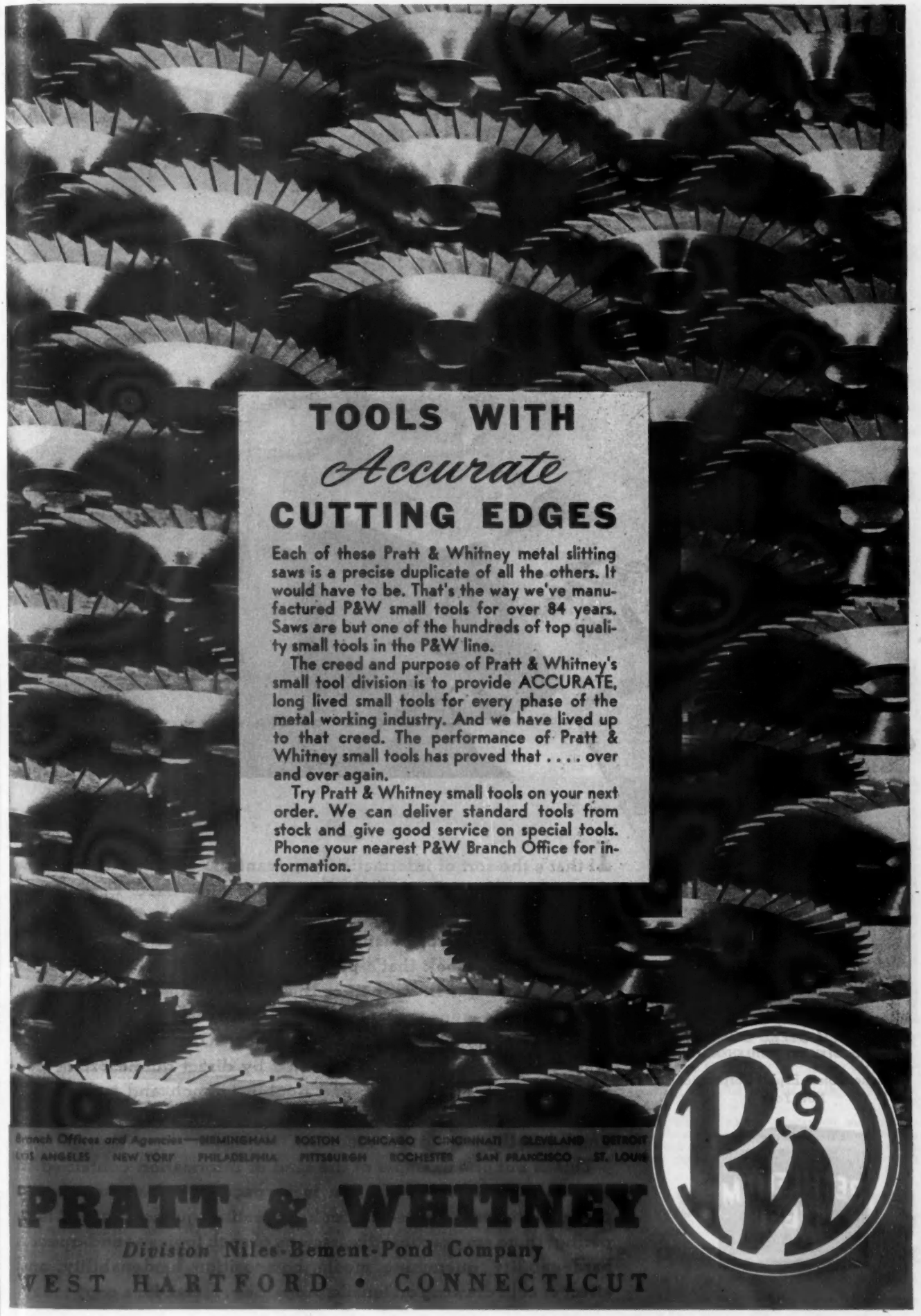


INLAND

INLAND Manufacturing

RUBBER, METAL, PLASTICS

Inland Products for Victory include Carbines, Tank Tracks, Gun Sights, Helmet Liners, Extinguisher Horns, and Rubber, Synthetic Rubber and Metal Parts for Tanks, Aircraft, Submarine Chasers, Torpedo Boats, Artillery Lighters and Landing Craft.


TOOLS WITH
Accurate
CUTTING EDGES
Each of these Pratt & Whitney metal slitting saws is a precise duplicate of all the others. It would have to be. That's the way we've manufactured P&W small tools for over 84 years. Saws are but one of the hundreds of top quality small tools in the P&W line.
The creed and purpose of Pratt & Whitney's small tool division is to provide ACCURATE, long lived small tools for every phase of the metal working industry. And we have lived up to that creed. The performance of Pratt & Whitney small tools has proved that .... over and over again.
Try Pratt & Whitney small tools on your next order. We can deliver standard tools from stock and give good service on special tools. Phone your nearest P&W Branch Office for information.
Branch Offices and Agencies—BIRMINGHAM BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT
LOS ANGELES NEW YORK PHILADELPHIA PITTSBURGH ROCHESTER SAN FRANCISCO ST. LOUIS
PRATT & WHITNEY
Division Niles-Bement-Pond Company
WEST HARTFORD • CONNECTICUT

Looking for FACTS-FIGURES-TEST RESULTS on Today's Steels?

If that's the sort of information you want, ask for Bethlehem's new free book entitled "Properties of Frequently Used Carbon and Alloy Steels." It's just off the press after more than fifteen months of intensive research, testing, checking and rechecking; a 100-page reference book that's particularly valuable *now*, because of the many changes in steel since the outbreak of war.

For instance, suppose you want to know the recommended practice for maximum case hardness of NE 8720. On page 44 of the book you'll find the results obtained by direct quench from pot, single quench and temper, and double quench and temper. On page 45, the subject of maximum core toughness is similarly outlined, and the test figures recorded.

This is but one example of the kind of information contained in the book. There are, in addition, many pages of curves showing the properties of various steels after heat treating, quenching, and tempering; there are practical discussions of such topics as end-quench hardenability, quenching media, composition hardenability, and effect of cold drawing on tensile properties . . . Ask for a copy today.

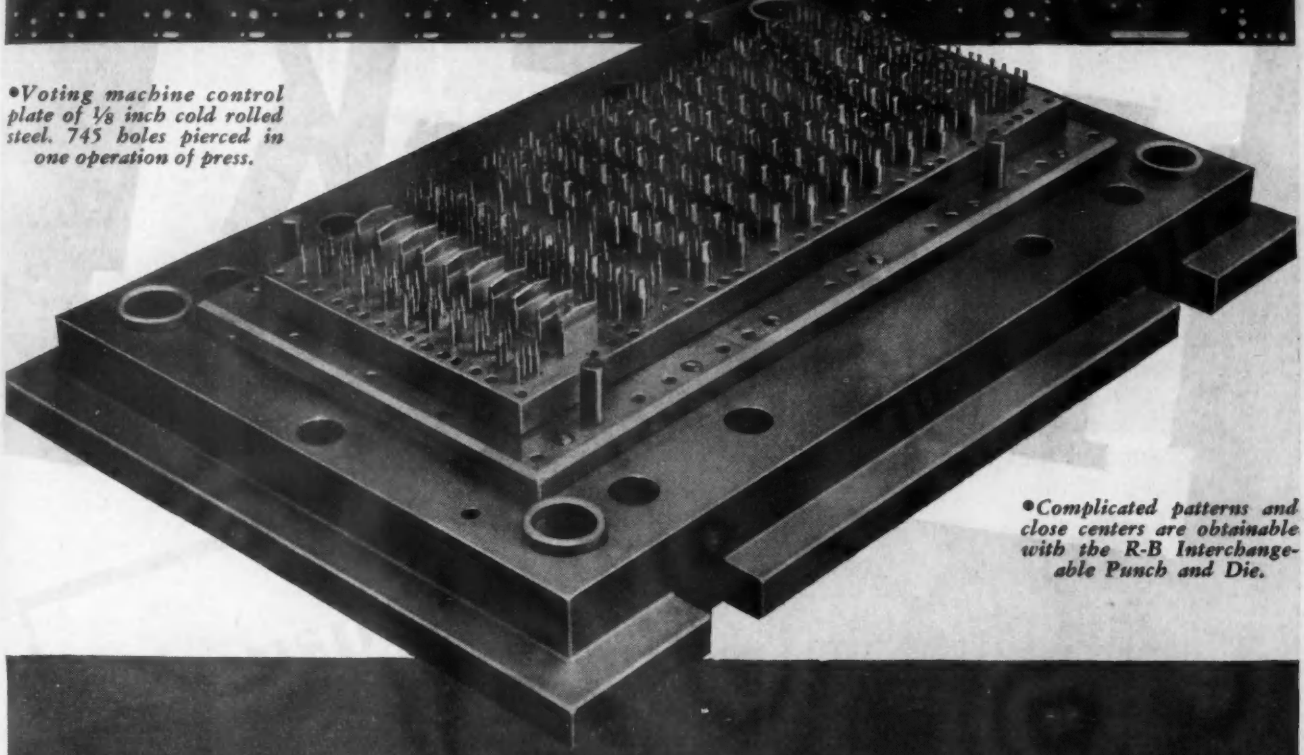
If you use, specify, or purchase wartime steels, you'll find this book one of the most informative publications ever distributed. Write in for a free copy today.

BETHLEHEM STEEL COMPANY
GENERAL OFFICES: BETHLEHEM, PA.

Bethlehem Steel Export Corporation
New York

BETHLEHEM STEEL

•Voting machine control plate of 1/8 inch cold rolled steel. 745 holes pierced in one operation of press.



•Complicated patterns and close centers are obtainable with the R-B Interchangeable Punch and Die.

THE ALLIED R-B PUNCH *Goes to the Polls*

Buy More War Bonds

This voting machine control plate, made from a 1/8 inch cold rolled steel sheet, has 745 holes—all pierced with one stroke of the press. Each of them is accurate in dimension and exactly centered. Many of them have diameters smaller than the thickness of the part.

The Richard Brothers patented Interchangeable Punch and Die has shouldered major wartime assignments in the metal-working and plastic industries. Its campaign ribbons have been won in front line attacks on production delays and high labor costs. It is destined to play an equally important part in the reconversion program. For more complete details of the R-B punch and die write for the R-B catalogue, or send in your layout problems to us.

• • •

"IT'S AN ALLIED PRODUCT!" . . . Allied Products Corporation and its divisions, Richard Brothers and Victor-Peninsular, in Detroit and Hillsdale, Michigan, also make: Sheet metal dies, from the largest to the smallest; plastic molds; jigs and fixtures; precision hardened and ground parts; and other special products.

ALLIED PRODUCTS
CORPORATION

Executive Offices: 4646 Lawton Ave., Detroit 8, Mich.

All four plants have now added a star to their Army-Navy "E" pennants

38 YEARS OF SERVING INDUSTRY

HANCOCK

TOMORROW

New time saving practices and better laboratory techniques will be available to you when peace comes. We are now ready to study your postwar plans.

HANCOCK MANUFACTURING COMPANY
JACKSON, MICHIGAN, U.S.A.
GEORGE P. HOOPER • SALES MANAGER
919 FISHER BUILDING • DETROIT

● *Built by* THE G. C. F. MOTORS CO.

Transportation demands tough buses

SKF

BALL AND ROLLER BEARINGS

A bus must have plenty of stamina to stand up under today's rush of war workers anxious to reach their jobs or to return home after the day's work is done.

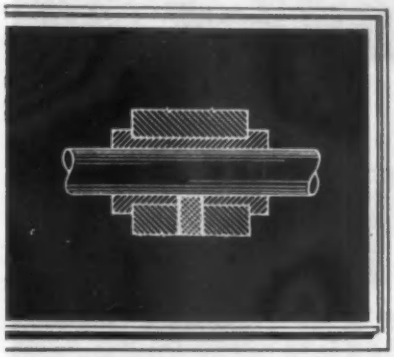
It must have *bearings* with plenty of stamina to withstand the shocks and loads of quick stops and starts in a stepped-up "on time" schedule.

That's why many bus owners have their mechanics use SKF Bearings for replacements . . . why they have buses that run profitably year in and year out. The right bearing in the right place makes the difference.

5526

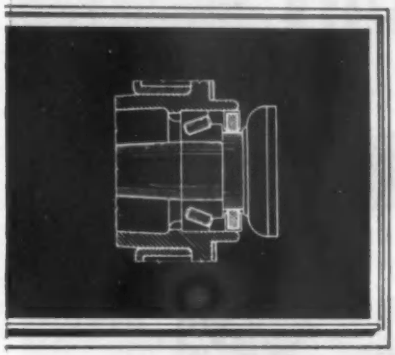
SKF INDUSTRIES, INC. • FRONT ST. & ERIE AVE. • PHILADELPHIA 34, PA.

Felters Felt has long-lived resiliency . . .



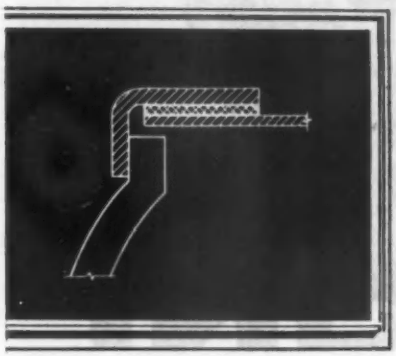
as feeds for bearing lubrications

Because Felters Felt is resilient, it maintains close contact with bearings with an extreme minimum of friction. Its tough, fibrous structure resists wear and deterioration from grease, helps make it an ideal capillary agent for moving grease and oil to bearing surfaces.



as grit & mud seals for tractor bearings

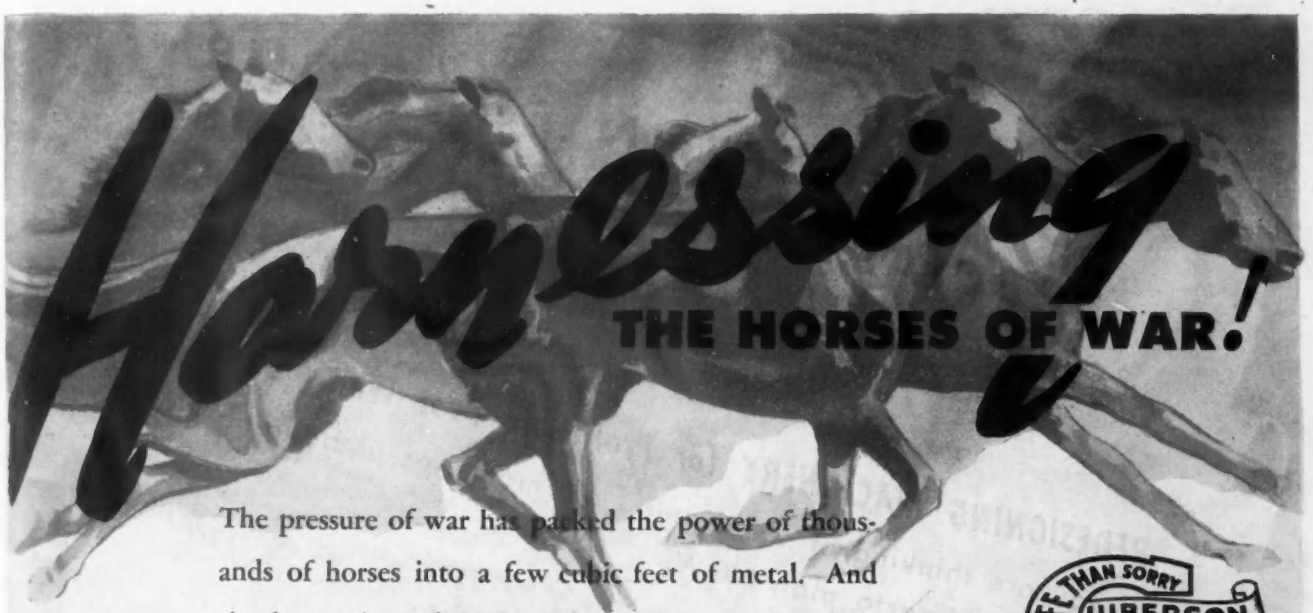
Resilient for adjustable fit, Felters Felt is easily formed to fit irregular housings. It is available in many thicknesses and consistencies, and can be adapted to your design requirements, rather than building the design around the seal.



as a sealing against air-borne dust

Packing strips of resilient Felters Felt prevent infiltration of dust around glass inserts in instrument cases and similar uses. There is a legion of uses for this felt that cuts without fraying, conforms to irregularities. You'll find a detailed description of many of these uses in our booklet, "Felt as a Design Material." Send for a free copy today. The Felters Company, 210R South Street, Boston, Massachusetts.

_____put in your post-war picture



Harnessing THE HORSES OF WAR!

The pressure of war has packed the power of thousands of horses into a few cubic feet of metal. And the harnessing of that power to the great bombers that daily are roaring to victory over Berlin and Truk requires master engineering and precision manufacture. The *MOTOR MOUNTS* for some of America's newest and largest bombers are being produced in the completely modern plants of the Guiberson Corporation. Care and precision in manufacture are the heritage of every Guiberson built aircraft part.

BETTER BE SAFE THAN SORRY
GUIBERSON
ESTABLISHED 1919

Guiberson

PRECISION BUILT

- Drop hammer parts of all kinds
- Sheet metal assemblies
- Flap track supports
- Fire walls
- Auxiliary seats
- Navigating seats
- Motor mounts
- Sumps
- Cowling parts and assemblies
- Exhaust manifolds
- Intake manifolds
- Gun windows or doublers
- Inter-cylinder baffles
- Gun nose boxes
- Camera windows
- Scoops
- Ducts
- High Altitude heating systems
- Gasoline tanks
- Hydraulic reservoirs
- Collector rings

Guiberson USA

THE GUIBERSON CORPORATION
GUIBERSON DIESEL ENGINE CORPORATION
DALLAS : : : : TEXAS

LOOK TO FENN FOR YOUR SPECIAL MACHINERY NEEDS

3 Generations of Fenns have specialized in building machinery. They have the designing and engineering skill backed by years of craftsmanship and experience.

REDESIGNING MACHINERY for Profitable Post War Production

If you are thinking of redesigning old machines or building new ones, it is time to plan NOW.

Fenn Aircraft BUILT PARTS FOR FAMOUS PLANES

Today Fenn is wholly engaged in war production. Thousands of precision parts and subassemblies flow from Fenn Plants into the construction of such famous planes as the Navy Corsair. Other Fenn parts and assemblies are made for ships, tanks, guns and vital war equipment.

FENN Plants - Strategically located for Efficient Service

Fenn plants, located at Hartford and New Britain, will once again build special machinery at the close of the war. The men with the skill and experience to solve machine design and development problems, will be ready to work with you. Planning, blueprinting and engineering can be done now. Your inquiries involve no obligation.

Experienced Designers and Machine Builders With A Long-Time Reputation for Precision Workmanship. We invite your inquiries.

THE FENN MANUFACTURING COMPANY

HARTFORD • CONNECTICUT

Design that part in

ArmaSteel*

A versatile metal that cuts costs—improves performance

First to define ArmaSteel: It is a highly machineable metal, cast to conform closely to final shape, and available in a wide range of physical properties. Any yield strength up to 90,000 lb. per sq. in. can be consistently obtained. Adaptability to selective hardening permits hardness rating of 50 Rockwell C and above.

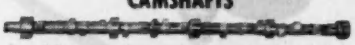
Replacing steel in varied applications, ArmaSteel has provided from 10 to 30 per cent better machineability—reduced the amount of metal to be removed to a fraction of previous requirements—increased the number of parts finished per tool grind as much as 100%. Equally advantageous have been the results obtained in performance through such desirable characteristics as excellent bearing properties, good fatigue life, high damping capacity and the ability of the metal to take a mirror finish when polished.

CAST FOR A LEADING ROLE IN INDUSTRY

ARMASTEEL DIESEL PISTONS

In actual use, ArmaSteel pistons have rolled up records of more than 1,000,000 miles of continuous service . . . far and away the best performance of any other materials used.

ARMASTEEL AUTOMOTIVE CAMSHAFTS



In addition to the machining advantages that apply to all ArmaSteel parts, the camshafts contribute to quiet car operation by their damping qualities. Selective hardening of cams is accomplished right on the machining line with a production set-up.

ARMASTEEL RECEIVER FOR .30 CALIBER AUTOMATIC RIFLE

Replace steel bar stock, ArmaSteel cut machining time from 16 hours to less than 2 hours.

ARMASTEEL HYDRA-MATIC TRANSMISSION GEAR

Use of ArmaSteel for transmission parts reduces machining requirements, lessens tool wear and contributes to satisfactory performance.

WAR BONDS SAVE AMERICAN LIVES

*Reg. U. S. Pat. Off.

SAGINAW MALLEABLE IRON DIVISION OF GENERAL MOTORS

SAGINAW, MICHIGAN

SOLVE YOUR REMOTE CONTROL problems with Sperry's line of HYDRAULIC REMOTE CONTROLS

featuring the famous EXACTOR--

Sperry's EXACTOR HYDRAULIC CONTROL, by means of a flexible, unique, single-tube system, has solved hundreds of remote control problems for design engineers in many industries.

With over 60,000 units now installed on marine, aviation and general industrial equipment geared to war's demands for dependable, maintenance-free operation, the EXACTOR HYDRAULIC CONTROL is saving thousands of dollars and hundreds of engineering hours for many of America's top-notch designers in these fields.

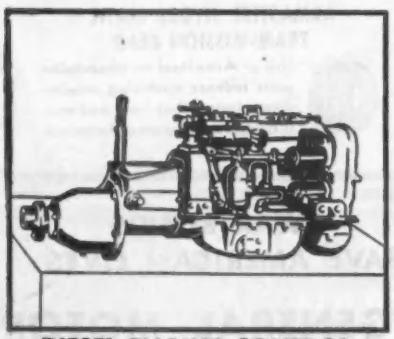
Accurate and self-contained, requiring no special engineering to install and maintain, the EXACTOR HYDRAULIC CONTROL is well worth investigating if you have a control problem involving the accurate transmission of applied motion over distances up to 200 feet.

Sperry's EXACTOR HYDRAULIC CONTROL is rated at 125 inch-pounds torque in either direction or as high as 400 inch-pounds in one direction.

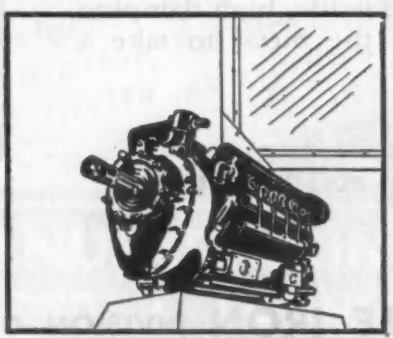
SPERRY PRODUCTS INC.

Hoboken New Jersey

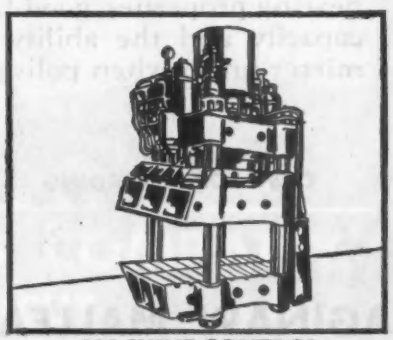
WRITE FOR DESCRIPTIVE BULLETIN 78-E



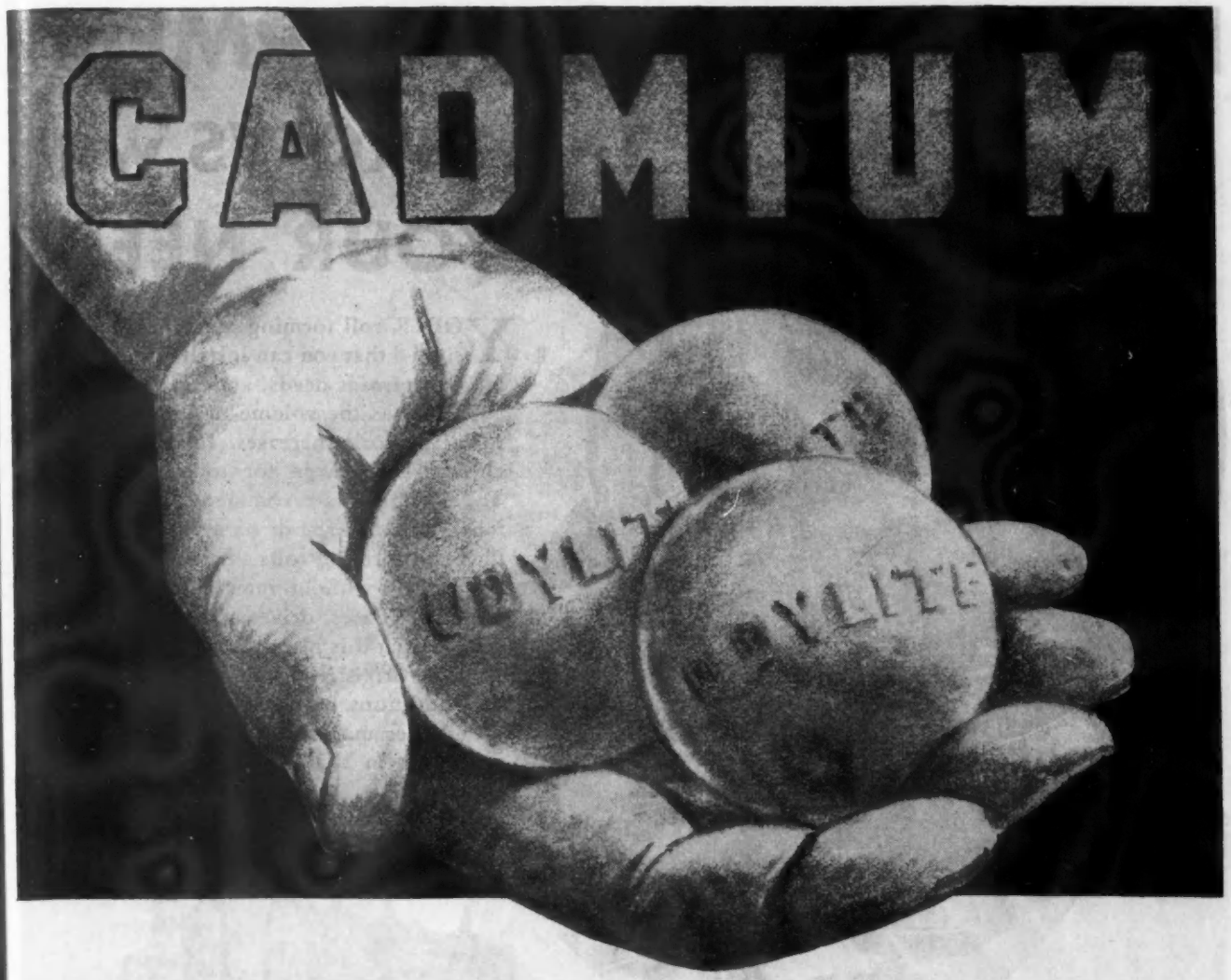
DIESEL ENGINE CONTROL



TEST STAND CONTROL



MACHINE CONTROL



BY UDYLITE

Since the introduction of Cadmium as a metal protecting coating, the Udylite Corporation has been its foremost advocate and pioneer.

Cadmium is a "natural" protective coating, inert to the ravages of the elements, highly ductile, resistant to abrasion and wear, and last but not least, beautiful to look at as well.

Of course Cadmium is worthless without the knowledge and experience necessary for its successful application. Udylite has that "know how" gained through years of pioneering its use and thousands of dollars spent in developing better, and still better equipment and processes for its application.

CADMIUM BY UDYLITE is an eye-appealing protective coating warranting your investigation.

Our years of experience and experimentation are a plus value which costs you nothing.

THE UDYLITE CORPORATION

1651 E. Grand Blvd., Detroit 11, Mich.

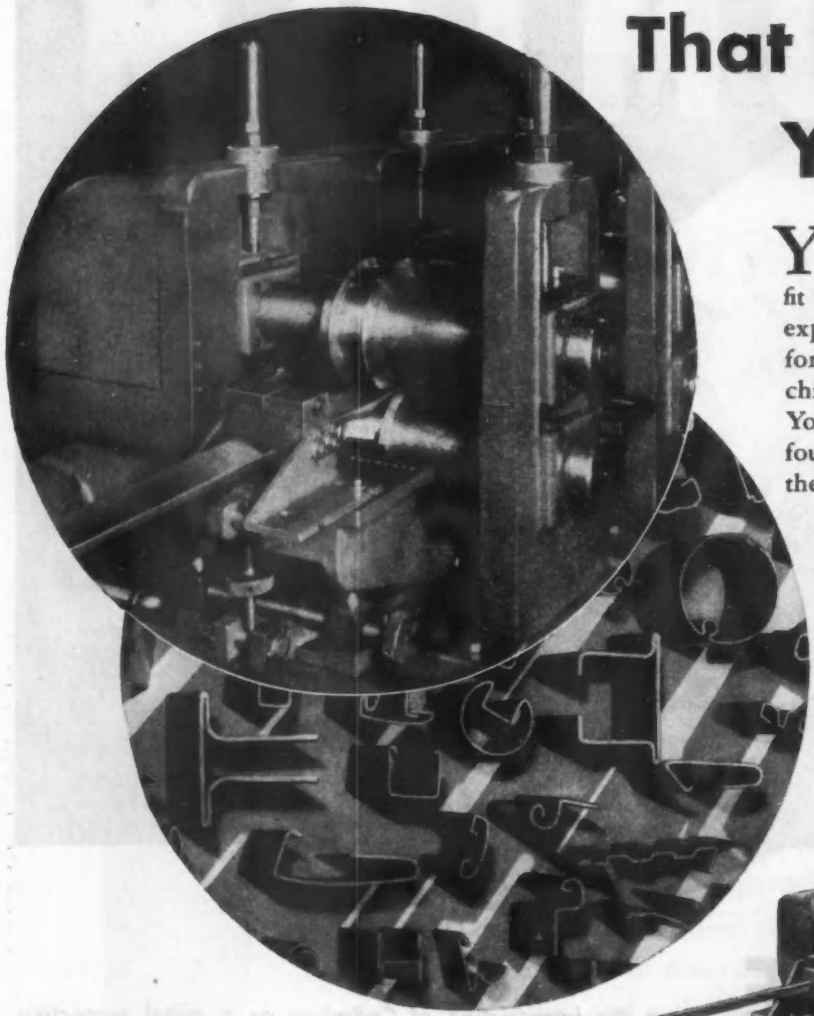
Chicago 12
1943 Walnut Street

Long Island City 1, N. Y.
11-16 44th Drive

Cleveland 3
4408 Carnegie Ave.

ROLL FORMING EQUIPMENT

That GROWS with YOUR NEEDS



YODER roll forming machines are so designed that you can install units to *exactly* fit your current needs, and yet be very easily expanded as the volume or intricacy of your forming work increases. If a ten-stand machine is too large for today's production, Yoder engineers recommend that you install four or six roll stands on a base built for ten, then add forming rolls as your work calls for them—without interruption of production. Bases, drives and stands are made so that this plan works perfectly . . . and the original machine pays for all future additions by profitable operation. Let a Yoder man show you how this can be done in YOUR plant.

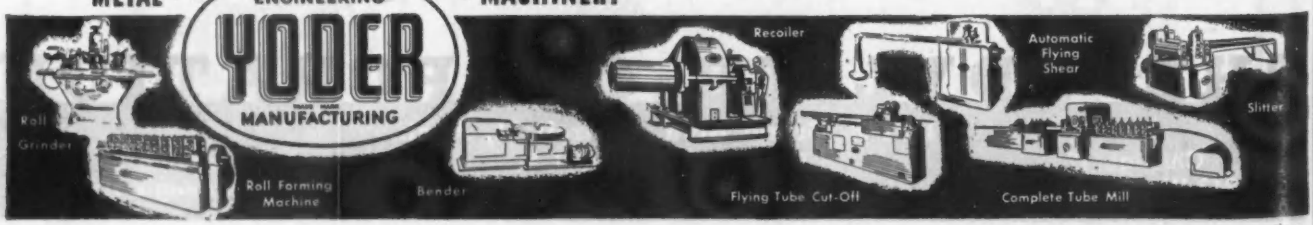
The variety of forms produceable on Yoder roll forming machines, and the simplicity of the forming units (above) are typical of Yoder production equipment, the basic idea of which is to "get it out with the least fuss, at minimum cost." At left is a unit set for simple roll forming with six rollstands, and expansion room for four more.

Write for detailed information or our General Bulletin

METAL • WORKING • PRODUCTION • MACHINERY

ENGINEERING **YODER** MANUFACTURING

THE YODER CO., 5500 Walworth Ave., Cleveland 2, Ohio, U. S. A.



PORTRAITS OF PROGRESS

TRADE ABRASIVE MARK REGISTERED

RECENT "ABRASIVE" MILESTONES

RED STREAK FLANGES—For High Speed Reinforced Bonded Snagging Wheels and Larger Sizes.

RED STREAK BUSHINGS—for Rotex Chucks.

VICTORY POINTS—Mounted Wheels and Points with Patented Demountable Shanks.

ABRASIVEWAY—Newest Development in Tool Sharpening.

Write for FREE Information. Please ask for Grinding Wheel Data Book.

These THEN and NOW pictures of ABRASIVE COMPANY'S Main Office and Factory portray a contrast which emphasizes steady and substantial progress throughout more than half a century. This progress, built by skill, experience and research is responsible today for the wide acceptance of Abrasive Company Grinding Wheels and other Abrasive Products. It is likewise your assurance of

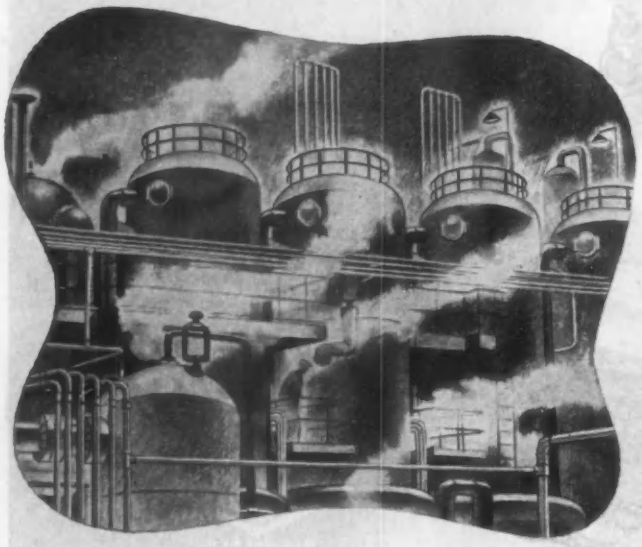
COMMANDING QUALITY *and* OUTSTANDING RESULTS

ABRASIVE COMPANY

DIVISION OF SIMONDS SAW AND STEEL CO.

TACONY & FRALEY STS., PHILADELPHIA, PA. • DISTRIBUTORS IN ALL PRINCIPAL CITIES

INDUSTRY'S NEW SOURCE OF CONTROLLED POWER



Fluid Power

MAKES MOLECULES BOUNCE!

In synthetic rubber plants, Fluid Power helps pry the molecules apart and squeeze them into new combinations. Liquids and gases are measured, mixed and transformed to meet the exacting standards of chemical formulas.

Fluid Power is transmitted through tubes. It helps to drive, control and regulate . . . all the way through from the raw ingredients to the bouncing tire.

Fluid Power is simple, dependable. And that's an essential in the complex operations of rubber and chemical plants and modern oil refineries. Whether the job calls for precision timing or powerful, remote control, Fluid Power does it efficiently—and without coddling!

Where and how can Fluid Power be put to work for you? The applications are limitless. A Parker engineer will be glad to discuss your problem with you.

AT YOUR SERVICE...FLUID POWER ENGINEERING

Solving power and control problems . . . engineering new Fluid Power systems is the day-to-day job of Parker engineers. In the marine, railroad, petroleum, Diesel, refrigerator and machine tool and other industries, they are developing new and interesting applications which you should know about. Ask a Parker engineer, or write direct to The Parker Appliance Company, 17325 Euclid Ave., Cleveland 12, Ohio.

THE
PARKER
APPLIANCE COMPANY
CLEVELAND • LOS ANGELES
FLUID POWER ENGINEERING

BIG or SMALL Consumers

They're All Equally Important to STRONGHOLD SCREW PRODUCTS

"Gentlemen:
"I must say I was surprised and pleased to receive your letter. Imagine a concern as large as yours asking for post-war business at the present time under the hardships which must confront you in the way of raw materials, etc. Yours is the only company which has written in regard to our business, small though it has been with you, and believe me when priority restrictions are lifted from inventory stocks, we look forward to having a complete stock of 'Stronghold' items."
(Signature upon request)

IT IS A matter of policy with STRONGHOLD that all orders or inquiries pertaining to fastening products are of EQUAL IMPORTANCE, regardless of the size of the order or the size of the company from which it comes.

STRONGHOLD serves many of America's industrial giants whose use of fasteners run into astronomical figures. It also serves, with equal promptness and concern, thousands of smaller companies whose use of fasteners is limited—but equally important in the construction of the products they make.

We welcome your inquiries for samples or prices of either standard or special screw products. You will hear from us promptly.

It's faster to telephone
Call WHitehall 4680

MANUFACTURERS SCREW PRODUCTS
201 W. Hubbard St. Chicago 10, Ill.

PROVED IN AMERICA'S WESTERN DESERT

it licked the SAHARA!

No one could have foreseen that tractors operating in America's western desert would help win the battle of the Sahara. But in desert war you fight an enemy common to every desert—dust and sand.

It was fine, cutting grains of sand collecting in the distributors of military vehicles that caused dangerous delays to the Allies. Then American engineering came up with an answer—the dust proof distributor originally designed by Auto-Lite to keep tractors working in the arid lands of the west. Allied tanks thus equipped . . . distributors free of dust . . . manned by "desert rats" of the United Nations' African Force rumbled to victory.

Today, Auto-Lite's dust proof distributor is standard equipment on many military vehicles. It is one more proof that the name Auto-Lite means precision manufacturing.

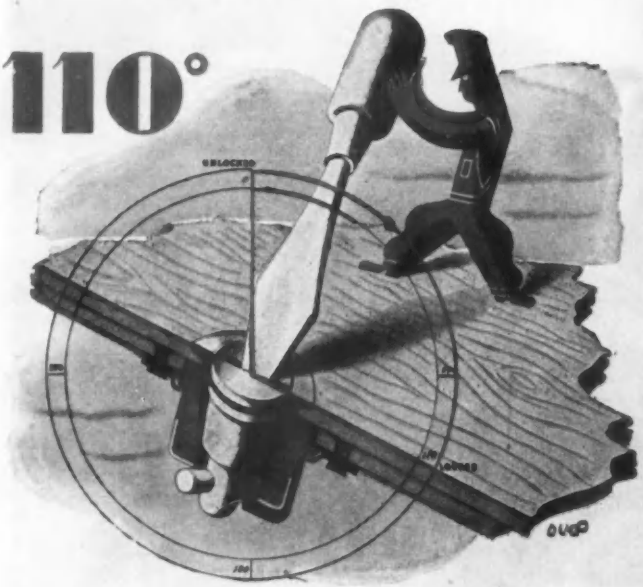
BUY WAR BONDS

THE ELECTRIC AUTO-LITE COMPANY
SARNIA, ONT. TOLEDO 1, OHIO

TUNE IN AUTO-LITE'S GREAT RADIO SHOW "EVERYTHING FOR THE BOYS"—EVERY TUESDAY NIGHT—NBC NETWORK

AUTO-LITE SPARK PLUGS · STARTING LIGHTING · IGNITION BATTERIES · WIRE & CABLE

110°



QUARTER TURN LOCKS OR UNLOCKS

Designed in answer to the aircraft industry's urgent need for quick easy operation of doors and access panels . . . millions of Camloc fasteners today serve round the world.

Camloc designs fasteners to fit precise needs. Whether you plan to make radios or vacuum cleaners, automobiles or washing machines, you'll find Camloc has much to offer. For the accumulated knowledge and intensive experience that solved aircraft's fastener problem is at your service.

CAMLOC FASTENER CORP.
420 Lexington Avenue, New York 17, N.Y.

Designers and Manufacturers

CAMLOC SPEED FASTENERS

COPYR. 1943, Camloc Fastener Corp.

THERE'S NO PRIORITY ON IDEAS!

MEMO

Tom! See what "OH-38" can do for us!
RM

● Here's Your Metal for Post-War products . . .

No matter what products you are planning to make for the post-war era, from heavy machinery to household utility articles, there are component parts which can be made better, faster, cheaper—with OH 38.

It's an aluminum alloy—easily machinable—easy on tools—holds threads without stripping—weighs .106 pounds per cubic inch—elongation 2% to 4%—non-corrosive, non-oxidizing, non-magnetic—does not require heat treatment—polishes to silver mirror brilliancy—takes chrome, nickel or tin plating—may be annodized—many other manufacturing advantages.

OH 38 has proven itself with 5 years use in hundreds of plants and it's used only in castings by Hedstrom.

Send for complete technical information

OSCAR W. HEDSTROM CORP.
4864 West Division St., Phone Columbus 3667, Chicago, Ill.
Manufacturers of Aluminum, Brass, Bronze and High Conductivity Copper Castings. Pattern Makers. Complete Mechanical Assemblies and Models to Specifications

A LEADING COSMETICS MANUFACTURER REPORTS:

"We cut down the size of our gift boxes and standard packages to effect an over-all saving of approximately 25% of the paper and cardboard; standardized our window displays and eliminated all die-cuts, as well as steps, shelves and secondary planes. We also folded all displays in half to save more than 50% of the paper and paperboard normally used."

A BIG PLATE GLASS COMPANY REPORTS:

"Our 1944 Color Book was reduced in size and quantity, resulting in a paper saving of 136,000 pounds. Our Color Cards, of which four or five million are used annually, were reduced in size at an approximate reduction of 50% in paper tonnage. We have eliminated our Dealer Sales Portfolio. Our Color Book has become a 'self mailer,' eliminating need for envelopes."

Mr. Manufacturer,

CAN YOU TOP THESE?

The quotations used in this advertisement are from responses to the A. N. A. Committee of Paper Saving.

ONE OF THE TOP LIFE INSURANCE COMPANIES REPORTS:

"In 1944 we will continue to specify lighter weights of paper wherever possible and take all possible steps further to reduce paper tonnage. We are instructing our field offices to scrutinize carefully all requests for printed material and to disapprove all requests for quantities that appear excessive."

A FAMOUS ADDING MACHINE COMPANY REPORTS:

"In advertising and promotion we are using about 30% of the amount of printing and paper used in 1941 — that represents about 2/3 saving. However, further savings will be effected whenever possible this year as last."

Remember—

PAPER IS WAR POWER

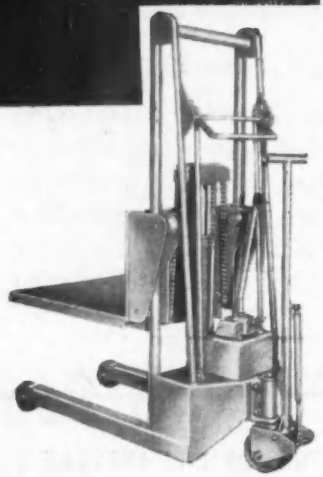
USE LESS—SAVE ALL WASTE PAPER!

This advertisement contributed by this publication and prepared by the War Advertising Council in cooperation with the War Production Board and the Office of War Information.

New!

STRONGER!

LIGHTER!



LYON-Raymond

Hydraulic

HIGH-LIFT TRUCK

Welded tubular steel construction gives the new LYON-Raymond High-Lift Hydraulic Truck exceptional lightness, rigidity and sturdiness. Lifts 1000 lbs. from 6" to 48". Fractional accuracy permits exact levelling. It starts and rolls easily on Timken bearings. Can be steered handily into any space that will accommodate its width. Double floor lock prevents movement of truck—an important safety feature. Ideal for placing tote boxes, setting heavy work in lathes, picking up, transporting and positioning heavy pieces. Handles most skid loads as easily as a low-type lift truck.

WRITE TODAY FOR ILLUSTRATED FOLDER NO. 136

LYON-Raymond
CORPORATION
366 Madison St., Greene, N. Y.

Plant Clearance For Reconversion

(*Continued from page* 18)

plants will be required, and Government will know from this information whether additional storage buildings must be erected to house unused machines, equipment and materials. Procurement agencies and WPB are responsible.

7.—CURRENT INVENTORIES

Reduce current inventories. Better distribution of surpluses now, and reduction of the amount of materials and parts in plants, and in process, will help to reduce the amount which will be on hand at the time of termination. In many cases such reduction can be made only when the manufacturer knows in advance regarding cutbacks and terminations.

It has recently been announced that the Army is preparing data on future supply requirements, and a timetable for cancellations and cutbacks. Such information is being made available to WPB soon. (Mr. Byrnes, June 12, 1944.) This should be available to manufacturers at the earliest possible date so they can properly relate their manufacturing to the supply picture. OWM, procurement agencies and WPB are responsible groups.

8.—SCRAPPING OF PARTS

Decide now about parts and material. What semi-finished products (parts-in-process) will be scrapped? Will it be more economical to finish the parts for some use or to scrap them immediately?

No policy set on this, so procedures remain undeveloped. However, the problme will arise in every plant, so policies are essential. This is a procurement agency responsibility.

9.—ALLOCATING STORAGE SPACE

Storage space. Allocate storage space in advance according to each contractor's requirements. Some warehouse facilities may have to be built. Decide now what materials and equipment can be stored out-of-doors.

Some surveys have been made by the services. Col. J. J. O'Brien heads up OWM committee on this. (The Automotive Council for War Production is surveying the machine tool situation in the automotive industry to obtain indication of the size of the storage problem.)

10.—DECISIONS ON SCRAPPING

Make scrapping decisions on the spot. Fortify officials with information on prices, values, usability, and technical aspects. Reinforce them with authoritative superiors on salvage boards, but insist that the decision to scrap machines, material or products must be made as soon as the facts are clear. *This point cannot be over-emphasized.* Prompt and courageous decisions on what should be scrapped could wipe out a major part of the plant clearance problem.

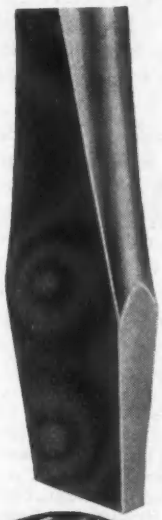
Growing tendency is for the con-

C/R

The best "soft" hammers and mallets are rawhide—tough, resilient, long-lasting, C/R mechanical rawhide. They strike effective blows without battering or marring . . . without fatiguing re-coil. They hold their true striking surfaces. Sizes and weights for every need. Hammers are malleable iron with replaceable C/R Rawhide insert faces.

Write for Catalog Sheets.

CHICAGO Rawhide MFG. CO.
1310 ELSTON AVE. ★ CHICAGO, ILLINOIS



New Bit Life in 60 Seconds

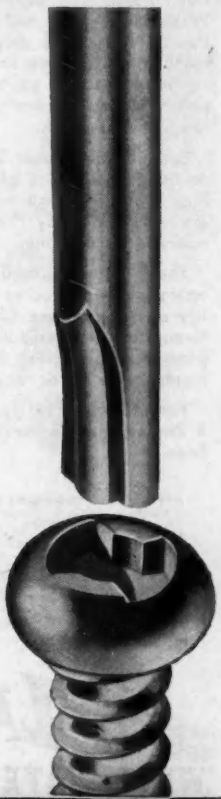
AGAIN, and AGAIN, and AGAIN this one-minute operation will restore the CLUTCH HEAD Type "A" Bit to its original efficiency. Contrast the elimination of cost and delay attained by this simple application of the end surface to a grinding wheel . . . as against the expense and bother of "back-to-the-factory" shipment of bits for reconditioning. Consider also, the rugged structure of this Type "A" Bit . . . a factor that enables it to deliver *a longer uninterrupted spell of service* on the Line between reconditioning grindings. The definitely longer total life of CLUTCH HEAD Type "A" Drivers is an economy item that has a direct bearing on final production costs.

CLUTCH HEAD offers seven major features that contribute to faster, safer, and lower-cost production and service. You may examine and test these features right at your own desk. Ask us *to mail* you sample of this Type "A" Bit along with package assortment of CLUTCH HEAD Screws and illustrated Brochure. You will discover why CLUTCH HEAD is The Screw That Sells Itself.

This is the *only* modern screw that may be operated with the ordinary type screwdriver; even with a piece of flattened steel rod in emergency . . . so important in simplifying field problems in war and peacetime service.

CLUTCH HEAD · SCREWS ·

Note the straight-walled Clutch matched by the straight sides of the Driver. No tapered entry to create ride-out tendency. No end pressure required. This means elimination of fatigue factor for sustained high production.



UNITED SCREW AND BOLT CORPORATION

CHICAGO CLEVELAND NEW YORK

tracting officer to declare property surplus and transfer to Reconstruction Finance Corp. rather than exercise his responsibility in these cases. This results in extra loss of time because goods are stored, case restudied, new decisions sought, and the procedures of termination are uselessly jammed with repetitive work. So far, there is no control over this in Government agencies.

11.—SPECIFICATIONS

Establish specifications for storing Government-owned property out-of-doors. Need for out-of-doors storage should be squarely faced now. (When conversion to war work was underway, industry shoved its special-purpose automotive machines into the open. Manufacturers attempted to protect the equipment with grease and waterproof paper but, *because of fire hazard, many had to remove the protection.*) Check up now on standards for indoor storage.

No satisfactory standards are laid down for out-of-doors storage of Government property. Indoor storage specifications are incomplete and not widely known. This is a responsibility of procurement and disposal agencies.

12.—READJUSTING SCHEDULES

When everything possible has been done to prepare for prompt clearance of plants, it is time to re-gage the size of the remaining job and fit it in *anew* with the reconversion timetable. Keep at the job of scaling down the problem and saving time. The Government representative's objective should be to help the contractor reduce the 30 days (estimated) period for inventory work, and eliminate the 60 day wait, or most of it.

Advance work has not yet reached this stage. Each agency, but particularly procurement and disposal agencies, is responsible.

13.—SUBCONTRACTING PLANTS

Complete a similar pre-clearance job down through the subcontracting levels.

This is not yet being done but should be occupying the attention of contracting officers today.

Gabriel Production

(*Continued from page* 25)

virtually endless. It is difficult to estimate the actual number of sizes that can be produced, since their number is legion. For example, the sizes made here range from a minimum of ¼ in. in diameter to a maximum of 15 in. in diameter. However, each machine is capable of adjustment to produce tubing in fractional increments within its maximum range. Actually the user can get any size between the limits of ¼ to 15 in. in diameter.

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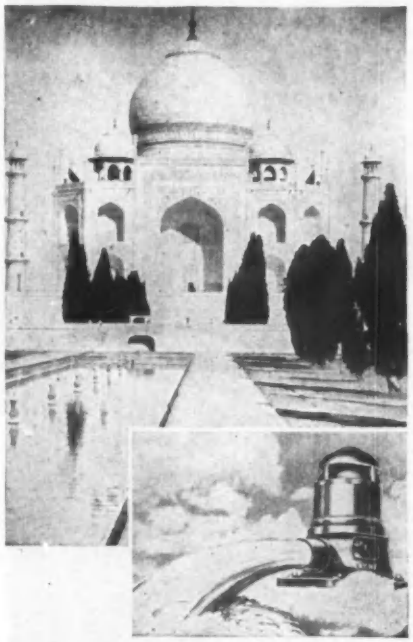

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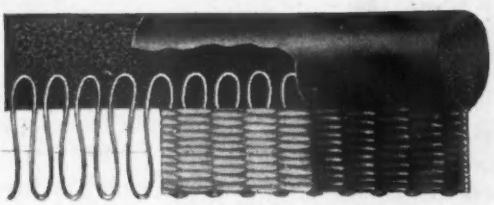

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ACCA Being Reorganized

(*Continued from page* 44)

of the Contract Termination Unit in Washington and Dayton. The Termination Unit reports the industry's views to the military and government agencies and keeps the industry informed on the latest developments. The work of the Termination Unit is co-ordinated by the Chamber management and supervised by a new Contract Termination Committee composed of the chief company executives responsible for termination supervision.

The committee structure of the Chamber has been simplified and the number of committees has been greatly reduced. The following committees of the Aircraft Manufacturers Council have been authorized:

Contract Termination; Accounting; Surplus Aircraft, aircraft Engines & Components; National Defense; Commercial Aviation; Research and Statistics; Public Relations, and Industrial Relations.

In addition there will be the following committees of the Aeronautical Chamber, as distinguished from the Aircraft Manufacturers Council:

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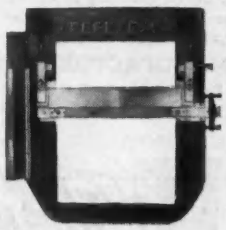

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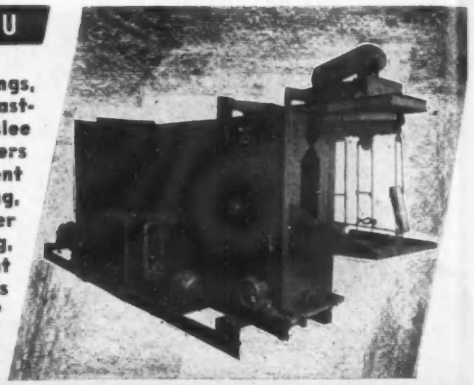

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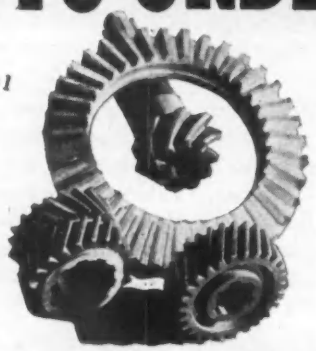

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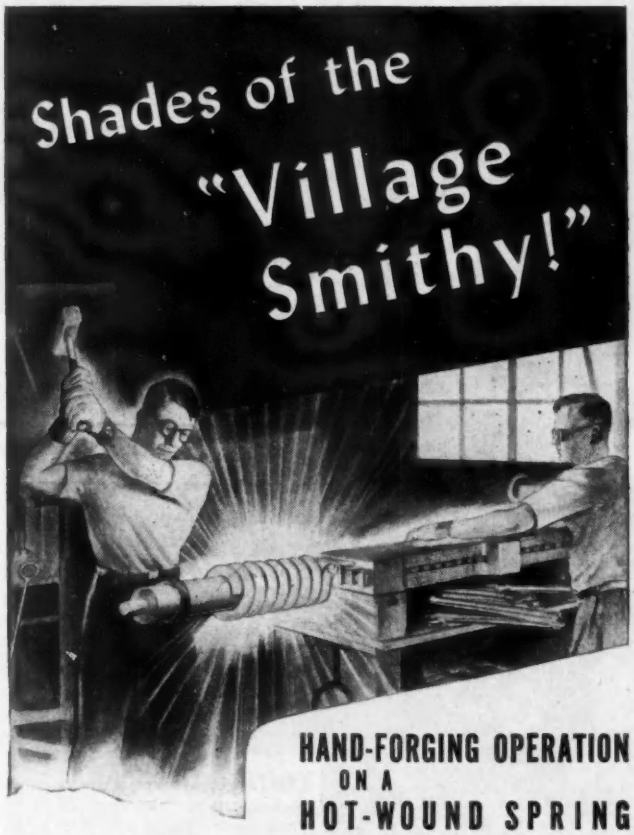

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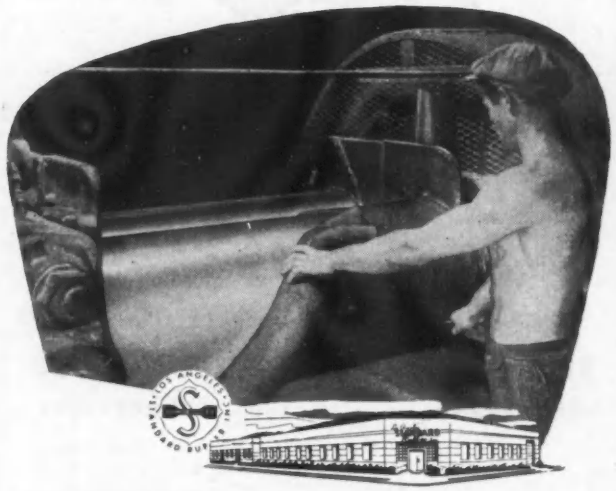

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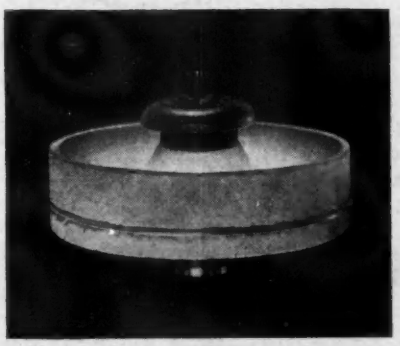

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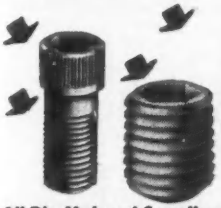

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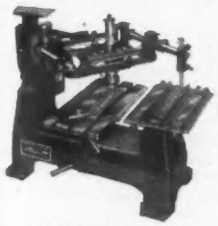

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B-H Aircraft Co., Inc. 159 B-W Superchargers, Inc. 105 Bakelite Corp. — Baker Ind. Truck Div. Baker Raulang Co. — Baldwin Southwark Div. 125 Bantam Bearings Div., The Torrington Co. 162 Barber-Colman Co. — Bardwell & McAlister, Inc. — Barnes Co., W. F. & John — Bauer & Black Div. of Kendall Co. 124 Bearings Co. of America — Bendix Aviation Corporation Bendix Products Div. 14 Eclipse Machine Div. — Bendix-Westinghouse Automotive Air Brake Co. — Berg Engineering Service — Bethlehem Steel Co. 132 Bijur Lubricating Corp. 54 Birdsboro Steel F'dry & Mach. Co. — Black & Decker Electric Co. — Blakeslee & Co., G. S. 154 Blanchard Machine Co., The 89 Bliss & Laughlin, Inc. — Boots Aircraft Nut Corp. — Borg & Beck Div. Borg-Warner — Borg-Warner Corp. — Bower Roller Bearing Co. 121 Bridgeport Fabrics, Inc. 151 Bridgeport Thermostat Co. — Bristol Co., The 91 Brown-Lipe Gear Co. 57 Brush Development Co., The 109 Bryant Chucking Grinder Co. 69 Buell Manufacturing Co. — Bullard Co., The 106 Bulldog Electric Products Co. 116 Bundy Tubing Co. — Bunting Brass & Bronze Co. — Burdett Manufacturing Co. 157 Burgess-Norton Mfg. Co. —

Camloc Fastener Corp. 146 Campbell, Andrew C., Div. Amer. Chain & Cable Co., Inc. — Campbell, Wyant & Cannon Foundry Co. 108 Cannon Electric Development Co. — Carbide & Carbon Chemicals Corp. — Carboloy Co., Inc. — Cardox Corp. — Carnegie-Illinois Steel Corp. 128 Carpenter Steel Co. 53 Celanese Celluloid Corp. 93 Central Equipment Co. 158 Central Screw Co. 91 Chace Co., W. M. 78 Chambersburg Engineering Co. — Chandler Products Corp. 91 Chicago Rawhide Mfg. Co. 148 Chicago Screw Co., The 70 Chicago Show Printing Co., Inc. — Cincinnati Milling Machine Co. 16 Cities Service Oil Co. 75 Clark Equipment Co. 103-104 Clark Trucktractor Div. Clark Equip. Co. — Clayton Mfg. Co. — Clearing Machine Corp. — Cleveland Pneumatic Tool Co. — Clifford Manufacturing Co. — Climax Molybdenum Co. — Cold Metal Products Co., The — Columbia Steel Co. 128 Cone Automatic Machine Co., Inc. 51 Connecticut Hard Rubber Co., The 118 Consolidated Vultee Aircraft Corp. — Continental-Diamond Fibre Co. 96 Continental Machines, Inc. — Continental Rubber Works — Continental Screw Co. 91 Corbin Screw Corp., The 91 Cotta Transmission Corp. 1 Crane Packing Co. 126 Cullen-Friestedt Co. 152 Cunningham Co., M. E. 156 Curtis Pneumatic Machinery Div. of Curtis Mfg. Co. —

Danly Machine Specialties, Inc. 159 Dardelet Threadlock Corp. 88 Davis & Thompson Co. 159 Dazor Manufacturing Co. — Dearborn Gage Co. — De Bothezat Div., American Machine & Metals, Inc. — Deepfreeze Div. Motor Products Corp. — Denison Engineering Co., The 43 Designers for Industry, Inc. 152 Detrex Corp. 158 Detroit Broach Co. — De Walt Products Corp. 110 Diamond Tool Co. — Disston & Sons, Inc., Henry — DoAll Company — Dole Valve Co., The 64 Dow Chemical Co. 13 du Pont de Nemours & Co. (Inc.) 117 Duro Metal Products Co. — Dykem Co., The 158 Dynamic Air Engrg. Inc. 112

Eaton Mfg. Co., Wilcox-Rich Div. — Eclipse Machine Division Bendix — Elastic Stop Nut Corp. of America 111 Electric Auto-Lite Co. 145 Electric Furnace Co., The 158 Electric Storage Battery Co. 97 Electrix Corp. 74 Electro Metallurgical Co. — Electro Products Laboratories — Emerman Machinery Corp. — Emerson Electric Mfg. Co., The — Empire Electric Brake Co. — Equitable Bearing Co. Inc. — Eutectic Welding Alloys Co. — Ex-Cell-O Corp. 11

Fairfield Mfg. Co. 154 Federal-Mogul Corp. — Federal Press Co., The — Federal Seal Company — Felters Co., The 136 Fenn Manufacturing Co., The 138 Firestone Industrial Products Co. — Fischer & Porter Co. — Fisher Furnace Co. — Fitchburg Grinding Machine Corp. 77 Fitzgerald Mfg. Co., The — Flex-O-Tube Co., The 102 Foote Bros. Gear & Machine Corp. 10 Formica Insulation Co., The —

Fostoria Industrial Service — Fuller Mfg. Co. — Fulton Sylphon Co., The —

G & O Mfg. Co. 155 Gabriel Co., The 158 Gairing Tool Co., The 95 Galland-Henning Mfg. Co. — Garrett Co., George K. — Gear Grinding Machine Co. — General Analine & Film Corp. — General Controls — General Electric Co. 150 General Machinery Corp. 113

Index to

The Advertisers' Index is published of the advertising contract. Every rectly. No allowance will be made

General Screw Mfg. Co. 91 Gibson Company, Wm. D. 155 Gisholt Machine Co. 8-55 Globe Steel Tubes Co. — Govro-Nelson Co., The — Grammes & Sons, Inc., L. F. — Grand Specialties Co. — Great Lakes Steel Corp. — Greenlee Bros. & Co. — Grizzly Mfg. Co. — Guiberson Diesel Engine Corp. 137

Hall Mfg. Co. — Hancock Manufacturing Co. 134 Hansen Mfg. Co. — Harper Co., The H. M. 91 Harrisburg Steel Corp. — Hayes Industries, Inc. — Heald Machine Co., The — Hedstrom Corp., Oscar W. 146 Herbrand Corp. — Hercules Powder Co., Inc. — Hills-McCanna Co. — Hollingshead Corp., R. M. — Holliston Mills, Inc., The — Hooven, Owens, Rentschler Co. 113 Hoover Ball & Bearing Co. — Houdaille-Hershey Corp. — Houghton & Co., E. F. — Howell Electric Motors Co. 120 Hyatt Bearings Div. G. M. Corp. — Hycar Chemical Co. — Hydraulic Press Mfg. Co., The — Hydropress, Inc. —

Independent Engineering Co. — Indium Corp. of America — Industrial Gear Mfg. Co. 156 Inland Mfg., Div. G. M. Corp. 130 Inland Steel Co. — International Nickel Co., Inc., The 2 International Plastics Corp. — International Screw Co. 91

Jacobs Co., F. L. 79
Jenkins Bros. ..... —
Jessop Steel Co. ..... —
Johnson Bronze Co. ..... —
Jones & Lamson Machine Co. 71

Kearney & Trecker Corp. 81
Kempsmith Machine Co. ..... —
Kester Solder Co. ..... —
King-Seeley Corp. 123
Kling Bros. Engrg. Wks. ..... —
Kold-Hold Manufacturing Co. ..... —
Koppers Co. ..... —
Kropp Forge Aviation Co. ..... —

Ladish Drop Forge Co. ..... —
Lamson & Sessions Co. 91
Lapointe Machine Tool Co. ..... —
Layne & Bowler, Inc. 150
Lear Avia, Inc. ..... —
LeBlond Machine Tool Co., R. K. ..... —
Leeds & Northrup Co. ..... —
Libbey-Owens-Ford Glass Co. ..... —
Lift Trucks, Inc. ..... —
Lincoln Electric Co. ..... —
Lincoln Engineering Co. ..... —
Lincoln Park Industries ..... —
Lindberg Engineering Co. ..... —
Lister-Blackstone, Inc. ..... —
Littelfuse, Inc. 76
Lodge & Shipley Mach. Tool Co. 47

Logan Engineering Co. ..... —
Long Mfg. Div. Borg-Warner Corp. —
Los Angeles Standard Rubber, Inc. 156
Lyon-Raymond Corporation 148

McAleer Manufacturing Co. ..... —
McQuay-Norris Mfg. Co. (Aircraft Div.) ..... —
Magnaflux Corp. ..... —
Mahon Co., R. C., The ..... —
Mallory & Co., Inc., P. R. ..... —
Manufacturers Screw Products..91-144
Marman Products Co., Inc. ..... —
Mathews Conveyer Co. ..... —
Mechanics Universal Joint Division Borg-Warner Corp. ..... —
Mercury Aircraft, Inc. 157
Merz Engineering Co. ..... —
Metal Specialty Co. 122
Metroloy Co. 154
Michigan Leather Products Co. ..... —
Michigan Wire Cloth Co. ..... —
Micromatic Hone Corp. ..... —
Midland Steel Products Co. ..... —
Mid-States Equipment Co. ..... —
Milford Rivet & Machine Co. 91
Moline Tool Company ..... —
Moraine Products Div. ..... —
Morse Chain Company 127
Motor Products Corp. ..... —
Muehlhausen Spring Corp. ..... —
Muskegon Piston Ring Co. ..... —

National Acme Co., The 114
National Broach & Machine Co. ..... —
National Schools 157
National Screw & Mfg. Co., The .. 91
National Steel Corp. ..... —
National Tube Co. 128
New Departure Div. G. M. Corp., Front Cover
New England Screw Co. 91
Nichols & Sons, W. H. 129
Niles Tool Works Co. 113
Noblitt-Sparks Industries, Inc. ..... —
North American Electric Lamp Co. —
Northern Indiana Brass Co. 60
Norton Company ..... —
Nox-Rust Corporation ..... —

Ohio Rubber Co. ..... —
Onsrud Machine Works, Inc. ..... —

Paasche Airbrush Co. ..... —
Page Steel & Wire Div. American Chain & Cable Co., Inc. 94
Palnut Company, The ..... —
Panelyte Div., St. Regis Paper Co. —
Parish Pressed Steel Co. 57
Parker Appliance Company 144
Parker-Kalon Corp. 91
Pawtucket Screw Co. 91
Pease Co., The C. F. ..... —
Pedrick Piston Rings ..... —
Peerless Machine Co. 153
Pennsylvania Salt Mfg. Co. ..... —
Perfex Gage & Tool Co. ..... —
Permatex Co., Inc. ..... —
Permold Company, The 101
Pesco Products Co. ..... —
Pheoll Mfg. Co. 91
Phillips Screw Mfrs. 91
Physicists Research Co. 68
Pierce Governor Co., Inc., The 115
Pierce Paper Products Co. 12
Pioneer Rubber Co. ..... —
Pittsburgh Lectromelt Furnace Corp. ..... —
Pittsburgh Plate Glass Co. ..... —
Pittsburgh Steel Co. ..... —
Porter-Cable Machine Co. ..... —
Potter & Johnston Machine Co. 159
Poulsen & Nardon, Inc. ..... —
Pratt & Whitney (Division Niles-Bement-Pond Co.) 131
Precise Products Co. 155
Preis Engraving Mach. Co., H.P. 159
Presstite Engineering Co. ..... —
Progressive Mfg. Co., The ..... —
Purolator Products, Inc. ..... —

Racine Tool & Machine Co. ..... —
Ramsey Access Mfg. Corp. ..... —
Reading Screw Co. 91
Redmond Co., A. G. ..... —
Reeves Brothers, Inc. ..... —
Republic Steel Corp. ..... —
Resistoflex Corp. ..... —
Reynolds Metals Co. ..... —
Rhode Island Tool Co. ..... —
Rhodes & Co., Jas. H. ..... —
Riehle Testing Machine Div. American Machine & Metals, Inc. 92
Rockford Die & Tool Works, Inc... 158
Rockford Drilling Machine Div. .... —
Rodic Rubber Corp. ..... —
Rohm & Haas Co. ..... —
Ruby Chemical Co. 152
Russell, Burdsall & Ward Bolt & Nut Co. 91
Ryerson & Sons, Joseph T. ..... —

SKF Industries, Inc. 135
Saginaw Malleable Iron Div. G. M. 139
Salisbury Axle 57
Sav-way Industries ..... —
Scandia Mfg. Co. ..... —
Schrader's Son, A. ..... —
Sciaky Bros. 9
Scovill Mfg. Co. 91
Scully-Jones Corp. ..... —
Sealed Power Corp. ..... —
Seneca Falls Machine Co. 5
Service Caster & Truck Co. Div. of Domestic Industries, Inc. ..... —
Shakeproof, Inc. 91
Sheffield Corp., The ..... —
Sheldon Machine Co., The ..... —
Shore Instrument & Mfg. Co., The 154
Shuler Axle Co., Inc. ..... Back Cover
Sibley Machine & Foundry Corp.. 151
Siewek Engineering Div. of Domestic Industries, Inc. ..... —
Silent Hoist Winch & Crane Co. ..... —
Simmonds Aerocessories, Inc. 154
Simplex Products Corp. ..... —
Sisalkraft Company ..... —
Snap-on Tools Corp. ..... —
Snyder Tool & Engrg. Co. ..... —
South Bend Lathe Works ..... —
Southington Hardware Mfg. Co. 91
Speedway Mfg. Co. ..... —
Spencer Turbine Co. ..... —
Sperry Products, Inc. 140
Spicer Mfg. Corp. 57
Spun Steel Corp. ..... —
Square D Company ..... —
Standard Molding Corp. ..... —
Standard Oil Co. (Ind.) ..... 2nd Cover
Sterling Aluminum Products, Inc. .. —
Sterling Tool Products Co. ..... —
Stow Manufacturing Co. ..... —
Strom Steel Ball Co. 82
Stromberg-Carlson Co. ..... —
Stuart Oil Co., Ltd., D. A. ..... —
Sturdimatic Tool Co. ..... —
Sturtevant Co., P. A. ..... —
Superior Coach Corp. ..... —

Taylor Fibre Company ..... —
Texas Co., The 4
Thompson-Bremer & Co. ..... —
Timken Roller Bearing Co., The .. —
Tinnerman Products, Inc. ..... —
Titeflex, Inc. ..... —
Tobe Deutschman Corp. ..... —
Tomkins-Johnson Co. ..... —
Torrington Co., The 45-162
Tourek Mfg. Co., J. J. ..... —
Tube-Turns, Inc. 65-66
Tung-Sol Lamp Works, Inc. ..... —
Tuthill Pump Company ..... —
Tuthill Spring Co. 67
Twin Disc Clutch Co. ..... —

U. S. Automatic Corp. ..... —
Udylite Corp., The 141
Union Carbide & Carbon Corporation ..... —
United Screw & Bolt Corp. 149
United Specialties Co. 6
United States Rubber Co. .. 83-84-85-86
United States Steel Corp. 128
United States Tool & Mfg. Co. ... —

Van der Horst Corp. of America .. —
Vard, Inc. ..... —
Vascoloy-Ramet Corp. 158
Vickers, Inc. 49-61
Victor Mfg. & Gasket Co. 158
Vinco Corporation ..... —
Visco-Meter Corp. ..... —

Wadsworth Watch Case Co. ..... —
Waldes-Koh-I-Noor, Inc. ..... —
Walker, Harry 72-73
Walker-Turner Co., Inc. ..... —
Ward Products Corporation, The .. 119
Warner Electric Brake Mfg. Co. 7
Watson-Stillman Co., The ..... —
Waukesha Motor Co. ..... —
Weatherhead Co. ..... —
Wells Mfg. Corp. ..... —
Western Automatic Mach. Screw Co. 58
Western Felt Works 52
Westinghouse Elec. & Mfg. Co. 99
Wetmore Reamer Co. ..... —
Whitaker Cable Corporation ..... —
White, I. D. 156
White Dental Mfg. Co., The S. S. Whitney Metal Tool Co. ..... —
Wilcox Rich Div. Eaton Mfg. Co. —
Wilkening Mfg. Co. ..... —
Wittek Mfg. Co. 159
Wolverine Tube Div. 91
Woodworth Co., N. A. ..... —
Worcester Stamped Metal Co. 158
Wrigley, Jr., Co., Wm. 80
Wright Mfg. Div. American Chain & Cable Co., Inc. ..... —
Wyman-Gordon 87
Wyzenbeek & Staff, Inc. ..... —

Yankee Metal Products Corp. 158
Yoder Co., The 142
Young Radiator Co. 3
Young Spring & Wire Corp., L. A. 59

Zollner Machine Works ..... 3rd Cover

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as a convenience, and not as part care will be taken to index correct for errors or failure to insert.

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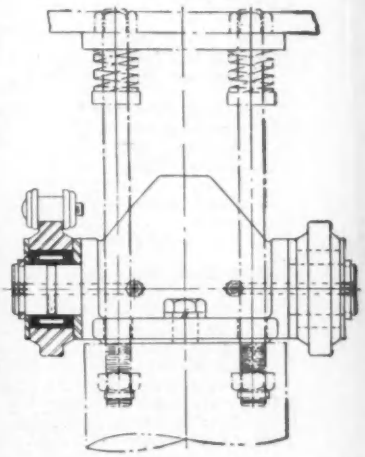
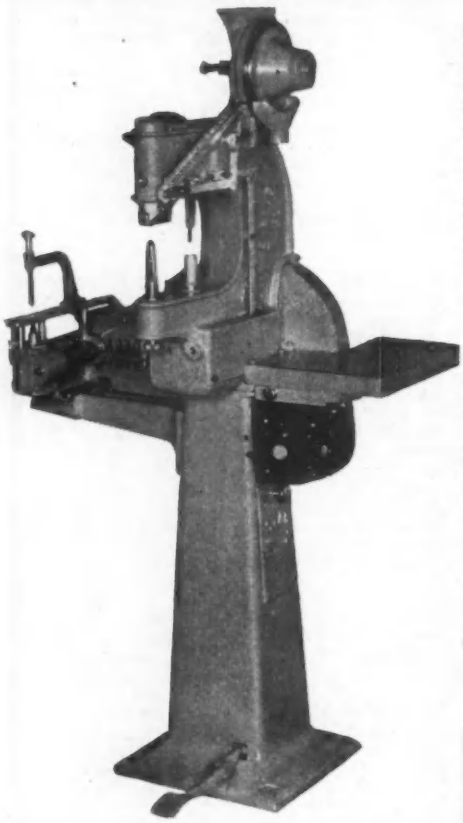


LIFT TRUCKS, manufactured by the Towmotor Corporation, are designed for the safe, rapid handling of multi-ton loads in around-the-clock service. To provide smooth operation in raising and lowering the load, Torrington NCS Needle Bearings are used on the hydraulic lifting cylinder crosshead. X-section clearly shows how compactness and high capacity of these bearings make them especially suitable for this interesting application.



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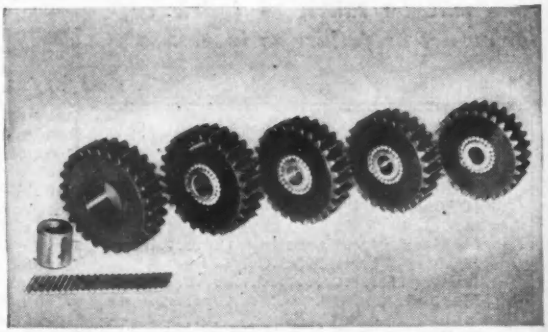
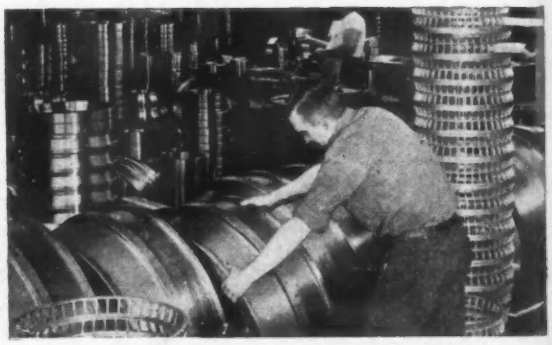


"OUT OF THE ORDINARY" bearing applications are an important phase of Torrington's Engineering Service. The specifications may call for a bearing of unusual size, or special design. Frequently a bearing previously engineered for one application can be adapted to meet the requirements of another. Man in foreground in photo at right is handling the inner race of a large double-row tapered roller bearing, a type widely used in heavy-duty mill applications.



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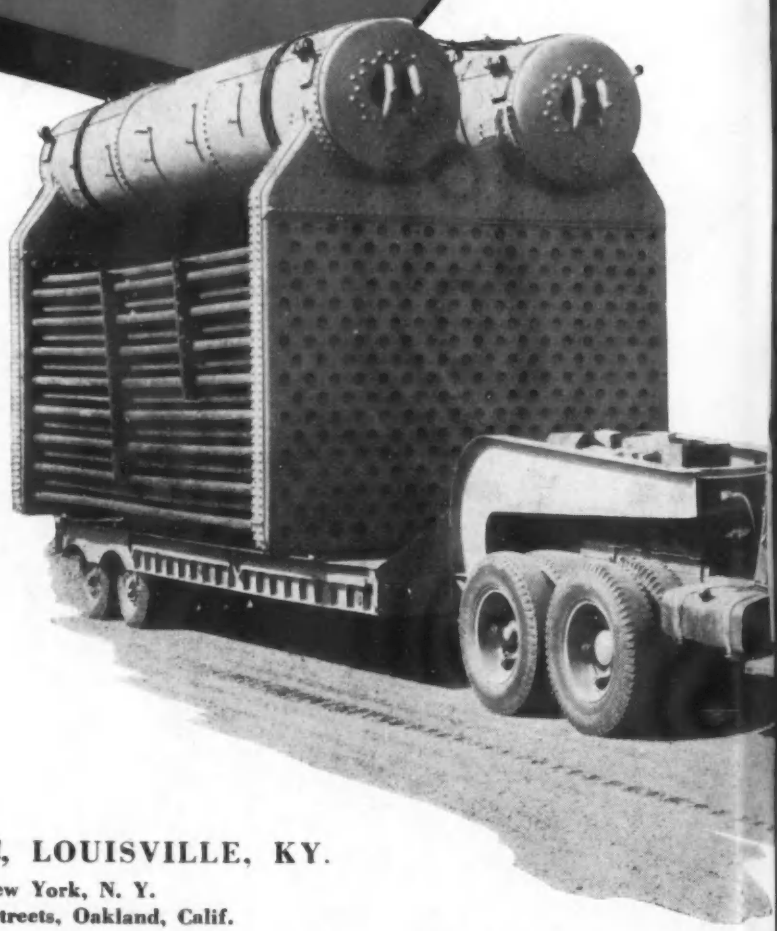

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